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State Regulations Pertaining to the Use of Internal Combustion Engines Underground

By Robert W. Waytulonis



UNITED STATES DEPARTMENT OF THE INTERIOR

United States Bureau of Mines.

Information Circular 8845

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**UNITED STATES DEPARTMENT OF THE INTERIOR
James G. Watt, Secretary
BUREAU OF MINES**

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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STATE REGULATIONS PERTAINING TO THE USE OF INTERNAL COMBUSTION ENGINES UNDERGROUND

by

Robert W. Waytulonis¹

ABSTRACT

The mining regulations of all 50 States were reviewed by the Bureau of Mines, and those parts pertaining to the use of internal combustion (IC) engines (particularly diesel engines) in underground mines or confined spaces were extracted. Also extracted were subjects associated with the use of IC engines; for example, storage and handling of flammable liquids, maintenance, and ventilation requirements. As the laws now stand, 29 States have specific regulations that affect the operation of diesel engines in underground coal and/or metal and nonmetal mines. The other States have no regulations because either they have no mining activities or they defer to Federal regulations. Six states have regulations expressly prohibiting the use of diesels in underground coal mines. Specific contacts (addresses and phone numbers) precede each State's regulations to facilitate inquiries about regulation revisions and interpretation.

INTRODUCTION

In 1938² and in 1957³, the Bureau of Mines surveyed State regulations pertaining to the use of internal combustion engines (particularly diesel engines) underground. Since the most recent study, the 1977 Federal Mine Safety and Health Act has been implemented, the Mine Safety and Health Administration (MSHA) has emerged as a Federal enforcement agency, and many States have made changes to their regulations. Additionally, increases in mine mechanization, in the form of diesel-powered equipment, are taking place as a result of the Nation's commitment to increase coal production and sustain other mineral supplies. For these reasons the Bureau has resurveyed State regulations to provide updated technical information for today's mining community.

¹Mechanical engineer, Twin Cities Research Center, Bureau of Mines, Twin Cities, Minn.

²Ilsley, L. C., and E. J. Gleim. State Regulations Pertaining to the Use of Internal-Combustion Engines in Coal and Metal Mines and in Tunnels. BuMines IC 7019, 1938, 8 pp.

³Holtz, J. C., and E. J. Gleim. State Regulations Pertaining to the Use of Internal-Combustion Engines Underground. BuMines IC 7789, 1957, 24 pp.

This report is a description of regulations as they were available in July 1980. It is strongly suggested that the agencies listed before each State's regulations be contacted for possible revisions and interpretation if absolute updated accuracy is required. For example, Pennsylvania's regulations currently state: "Underground equipment powered by internal combustion engines using petroleum products...shall not be used unless such equipment has been approved by the Secretary for underground use in bituminous coal mines." Table 2 shows Pennsylvania as a State not prohibiting diesels in coal mines, but the State Mine Inspector's office is not currently approving their use. Their use in rock tunnels as part of coal mines may be permitted.

ACKNOWLEDGMENTS

N. Paas and B. C. Dial of the Department of Engine and Vehicle Research, Mining Technology Section, Southwest Research Institute, are gratefully acknowledged for obtaining and providing copies of the 50 States' mining regulations through service contract.

STATE REGULATIONS

Tables 1-4 summarize the State regulations on the use of internal combustion engines underground, followed by extracts from the pertinent regulations of each State. Regulations for coal mines appear first, followed by those for metal and nonmetal mines.

TABLE 1. - States that have adopted Federal mining regulations

State	Coal	Metal and nonmetal	State	Coal	Metal and nonmetal
Alaska.....	X	-	Maryland.....	X	X
Arizona.....	X	-	Michigan.....	X	X
Arkansas.....	X	-	Minnesota.....	X	X
Connecticut.....	X	X	Mississippi.....	X	X
Delaware.....	X	X	Nebraska.....	X	X
Florida.....	X	X	New Hampshire.....	X	X
Georgia.....	X	X	New Jersey.....	X	X
Hawaii.....	X	X	North Carolina.....	X	X
Idaho.....	X	X	Pennsylvania.....	-	X
Illinois.....	-	X	Rhode Island.....	X	X
Indiana.....	-	X	South Carolina.....	X	X
Iowa.....	X	X	South Dakota.....	X	X
Kansas.....	X	X	Tennessee.....	-	X
Kentucky.....	-	X	Texas.....	X	X
Louisiana.....	X	X	Vermont.....	X	X
Maine.....	X	X			

TABLE 2. - Diesel engines in underground coal mines, by State

State	Prohibited	Regulated by State	MSHA-approved (permissible) equipment required
Alabama.....	X	-	-
Colorado.....	-	X	X
Illinois.....	X	-	-
Indiana.....	X	-	-
Kentucky.....	-	X	X
Montana.....	-	X	X
Nevada.....	-	X	-
New Mexico.....	-	X	-
New York.....	-	X	-
Oklahoma.....	X	-	-
Oregon.....	-	X	-
Pennsylvania.....	-	X	-
Tennessee.....	X	-	-
Utah.....	-	X	-
Virginia.....	-	X	X
Washington.....	-	X	-
West Virginia.....	X	-	-
Wisconsin.....	-	X	X
Wyoming.....	-	X	X

TABLE 3. - Diesel engines in underground metal and nonmetal mines, by State

State	Regulated by State	State approval or permit required	State	Regulated by State	State approval or permit required
Alabama.....	-	X	Oklahoma.....	X	X
Alaska.....	X	-	Oregon.....	X	-
Arizona.....	X	X	Utah.....	X	X
California.....	X	X	Washington.....	X	X
Colorado.....	X	X	West Virginia..	X	-
Massachusetts..	X	X	Wisconsin.....	X	X
Nevada.....	X	X	Wyoming.....	X	X
New Mexico.....	X	X			

TABLE 4. - Metal and nonmetal mine exhaust and ventilation requirements,
by State

State	Exhaust conditioning requirements ¹	Ventilation requirements ²	State	Exhaust conditioning requirements ¹	Ventilation requirements ²
Alabama.....	ET	-	New Mexico.....	T	75
Alaska.....	ET, T	100	Oklahoma.....	ET	-
Arizona.....	D, T	150, MSHA	Oregon.....	ET, T	100
California.....	ET	100	Pennsylvania.....	ET	-
Colorado.....	ET, T	75	Utah.....	D, T	150
Massachusetts.....	ET	75	Washington.....	-	75
Nevada.....	ET	150 NA	West Virginia.....	ET	-
		200 TC	Wyoming.....	T*	-

¹Key for exhaust conditioning requirements:

D--Dilution device required.

ET--Exhaust treatment required.

T--Maximum allowable exhaust gas temperature at discharge=180° F.

T*--Maximum allowable exhaust gas temperature at discharge=160° F for non-gassy mines and 170° F for gassy mines.

²Key for ventilation requirements:

75, 100, etc.--Minimum cfm per bhp.

MSHA--State will follow minimum requirements for MSHA certification.

NA--Naturally aspirated.

TC--Turbocharged.

ALABAMA

Contact:

Division of Safety and Inspection
Department of Industrial Relations
1816 8th Ave., North
Birmingham, Ala. 35021
205/251-1181

Coal Mines

Coal mining laws of the State of Alabama as amended 1975.

Hoisting and Haulage

Sec. 53. Prohibited Haulage Equipment

- (a) Non-permissible internal combustion engines or other machinery which gives off noxious fumes shall not be permitted underground in any coal mine.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines. Phone contact with the State Mine Inspector's Office indicated that a water-scrubber and state approval are required.

ALASKA

Contact: Division of Mineral Resources and Energy
Anchorage, Alaska
907/276-5113

Coal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground coal mines. Alaska has adopted Federal underground coal mining regulations.

Metal and Nonmetal Mines

State of Alaska Mines Safety and Conservation Regulations, 1975.

II AAC 44.328 Transportation of Men

- (f) Exhaust systems shall be installed and maintained in proper condition, and shall be so designed as to eliminate the exposure of men to the exhaust gases or fumes.

II AAC 44.398 Trackless Haulage Power

Every trackless haulage vehicle shall be provided with adequate rated power to carry its load safely up any grade over which it is intended to operate.

II AAC 44.840 Use of Diesel Engines Underground

The use of diesel equipment underground will be permitted providing the following conditions are met:

- (1) The diesel engine shall be equipped with an exhaust conditioner which will treat the exhaust gas so that when it issues into the mine atmosphere the temperature of the exhaust gas will not exceed 180° F at any time during a four hour shift.
- (2) The conditioner shall be large enough to hold sufficient water at all times. Water in the conditioner is to be completely drained and replenished once each shift, and the conditioner must be checked, serviced, and cleaned once each week or more often if necessary.

- (3) There shall be sufficient fresh air supplied so that there will be at least 100 cu ft/min of free air for each brake horsepower, in addition to the 100 cu ft/min of air required per person.
- (4) Working areas in which diesels are used shall be examined frequently and air samples taken to determine the mine atmosphere.
- (5) Operation of diesel equipment shall immediately cease when concentrations of any one of these toxic gases are found to exceed the following amounts:

carbon monoxide	0.01 vol-pct (100 ppm)
carbon dioxide	.5 vol-pct (5,000 ppm)
oxides of nitrogen	.0025 vol-pct (25 ppm)
aldehydes	.001 vol-pct (10 ppm)
- (6) Diesel equipment shall not be operated during any time when ventilating fans are shut down.
- (7) At least once each week an inspection of the diesel engine exhaust conditioner must be made and any necessary repairs made.
- (8) Diesel engines shall not be operated when flammable gas (methane) is found to exceed 1-1/4 vol-pct of air.
- (9) Oil used as fuel for diesels underground shall have a flash point of not less than 140° F, and the sulfur content shall not be greater than 1/2 of 1 pct by weight. Fuels with a heavy asphalt base shall not be used.
- (10) Only sufficient fuel oil for one shift shall be taken underground. Suitable, strong, sealed metal containers shall be used for this purpose and the empty containers removed immediately from underground locations.
- (11) The diesel engine fuel tank shall be filled by means of direct transfer only. Where possible, any oil spilled shall be taken up at once and deposited in a fireproof receptacle which shall be removed to an above ground location daily. (Eff. 8/1/63. Reg. 12).

ARIZONA

Contact:

Arizona State Mine Inspector
 705 West Wing--Capitol Building
 Phoenix, Ariz. 85007
 602/255-5971

Coal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground coal mines. Arizona has adopted Federal underground coal mining regulations.

Metal and Nonmetal Mines

Mining Code of the State of Arizona, 1976 Edition.

Art. 19, 1912 Mines

27-365: Regulation of Underground Use of Internal Combustion Engines. The underground use of any internal combustion engine is declared unlawful, unless after application filed with the inspector he approves the equipment for safe use in the type of underground work for which the application is filed and finds that the atmospheric conditions in the underground workings where the equipment is to be used are such that the operation of such equipment will not endanger the health or safety of any employee. If the application is approved by the inspector, the operation of the designated equipment shall be lawful only if and so long as it is operated and maintained in accordance with recommendations made public from time to time by the inspector, and only upon the condition that when air quality becomes unsafe, operation of the equipment shall be stopped by the operator until air quality again becomes safe either by increasing ventilation or by correcting mechanical imperfections in the equipment, whichever is found to be the cause of the unsafe quality of the air.

Art. 3 Fire Prevention and Control

R11-1-310:(4-46M): Gasoline, diesel fuel, liquefied petroleum gases and other flammable liquids when not buried, shall not be stored within 100 ft of the following:

1. Mine openings
2. Buildings or snowsheds connected to mine openings
3. Fan installations or housings
4. Hoist houses

R11-1-318:(4-21M): Internal combustion engines, except diesels above ground, shall be shut off and stopped before being fueled.

Underground Only

R11-1-321: Fuel stored underground will be in a return air split provided with adequate fire fighting equipment. No oil line shall be allowed to pass down the shaft.

R11-1-322:(5-54M): Oil, grease or diesel fuel stored underground shall be kept in suitable tightly sealed containers in fire resistant areas at safe distances from explosives magazines, electrical installations and shaft stations.

R11-1-323:(4227): A fire extinguisher of suitable type and size must be carried at all times with each diesel-powered unit.

- R11-1-324: The starting mechanism of the diesel engine shall be powered by electricity, air or some other source considered safe. The use of gasoline powered starters for underground diesel equipment is specifically prohibited.
- R11-1-325: Underground refueling stations must be well-ventilated and separate from any underground equipment repair areas. Diesel fuel must be carried in tight containers.
- R11-1-326: Only a day's supply of diesel fuel will be allowed underground at any time and this must be stored in tight containers in a cool, well-ventilated place. The container will be set in a sufficient amount of suitable absorbent material to absorb all of the fuel being stored or shall be set in an area which is curbed or otherwise blocked off so that the fuel cannot spread beyond the storage area.
- R11-1-329:(4-2M): No smoking is permitted in or around diesel fuel storage areas. No open lights are permitted in diesel storage or refueling areas. There must be adequate fire fighting equipment at all refueling stations and storage tanks for diesel fuel.
- R11-1-332: Fuel used in underground diesel equipment must conform to the manufacturer's specifications for viscosity, pour point, cetane number, carbon residue and water. The flash point must not be less than 150° F and sulfur content must not be greater than 0.2 pct by weight.

Art. 4 Air Quality, Ventilation, and Radiation

General

- R11-1-401: The discharge of any exhaust pipe for an internal combustion engine used for fans, power plant or engine driven compressor shall be located and so arranged that the exhaust fumes from this engine cannot under any conditions get into the intake air of the mine or the intake air of the compressor.

Underground Diesel Equipment

- R11-1-421: Pursuant to A.R.A., Paragraph 27-365, the underground use of any internal combustion engine is unlawful unless the Inspector has approved the equipment. In addition to the approval of the Inspector for use of the equipment, the equipment shall conform in all respects to the requirements of the rules set forth in this article.
- R11-1-422: Underground diesel-powered equipment shall be equipped with a stainless steel exhaust system including conditioner and satisfactory diluting device, which will reduce toxic gases to a minimum, before they are released into the mine atmosphere. (Except if limestone and water are used, scrubbers may be carbon steel.)

R11-1-423: The conditioner must not increase the engine back pressure above 18 inches of water or 1-1/2 inches of mercury when the diesel equipment is developing its rated horsepower. The conditioner must hold sufficient water for 4 hours of operation without replenishing and at the end of 4 hours of operation, the exhaust temperature again must not exceed 180° F. Water is to be completely drained and replenished once each shift. The conditioner must be checked, serviced, and cleaned once each week. Any other conditioner approved by Arizona State Mine Inspector may be used.

R11-1-424: At least once each week an inspection of the diesel engine and the gas conditioner MUST be made and a written report of its condition put on file for examination by the Mine Inspector or his deputies.

R11-1-425: When flexible tubing is used on exhaust from diesel motor to the air conditioner, or scrubber, it must be the type that will withstand back pressure and not leak.

R11-1-426 The use of diesel powered equipment shall be restricted to haulage way or other working places where positive ventilation is maintained by mechanical means. If possible, the ventilation in places where diesel equipment is used shall be arranged so that the air carrying exhaust gases from the engine are (sic) returned to the main air exhaust ways so as not to traverse working places.

R11-1-427: Diesel engines must not be operated when the atmosphere adjacent to its (sic) engine contains toxic gases above the tolerance set by the U.S. Bureau of Mines as listed below:

carbon dioxide	0.5 vol-pct
carbon monoxide	.01 vol-pct
oxides of nitrogen	.0005 vol-pct
oxygen must be at least 20 pct	

R11-1-428: When a diesel engine is used in underground mine operations, all dead-end headings shall be separately ventilated by auxiliary ventilation with a minimum air velocity of not less than 50 linear ft/min in the working face itself. The intake of the auxiliary exhaust system must be so located that air entering it will not be contaminated by exhaust gases from the diesel engine when operating between the intake and the face of the working area. When any portion of the primary or auxiliary exhaust system is not functioning, no diesel engine shall be allowed to operate in the area of no ventilation.

R11-1-429: If diesel equipment other than that approved by U.S. Bureau of Mines is utilized, 150 cu ft/min per brake horsepower is the required ventilated air for safe operation.

R11-1-430: A fire extinguisher of suitable type and size must be carried at all times with each diesel-powered unit. In addition, fire control systems shall be approved by the State Mine Inspector, for automatic, remote, pneumatic, push button or lever control.

R11-1-431:(9-4) Suitable lights and audible warning devices shall be installed and maintained in good working condition on all mobile diesel equipment operated underground.

R11-1-433: All diesel equipment must be checked for fuel leaks and any leaks found must be noted and reported.

R11-1-434: All connections and tubing from air cleaner to the intake manifold must be closely checked for cracks, breaks, or loose connections. The intake manifold must be secure and properly gasketed to cylinder heads, and be free of holes and cracks.

Art. 18 Gassy Mines
Equipment

R11-1-1852:(21-75M): Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face, and rib.

R11-1-1854:(21-78M): Only permissible equipment maintained in permissible condition shall be used beyond the last open crosscut or in places where dangerous quantities of flammable gases are present or may enter the air current.

ARKANSAS

Contact: Arkansas Department of Labor
Mine Inspection Division
247 Central Mall
Fort Smith, Ark. 72903
501/783-2103

Coal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground coal mines. Arkansas has adopted Federal underground coal mining regulations.

Metal and Nonmetal Mines

Arkansas Department of Labor, Safety Code No. 7
Relating to underground mining operations except coal mines.

7-13. COMBUSTIBLE LIQUIDS--STORAGE, TRANSPORTATION AND SUPPLY

7-13.1. Flammable Liquid

The term flammable liquid shall mean any oil or liquid that will generate a flammable vapor at a temperature below 100° F when tested in a Tagliabue open cup tester.

7-13.2. Storage of Flammable Liquid Fuel

All flammable liquids that are commonly used as fuel for the generation of light, heat or power when stored above the ground surface shall be stored at least 100 ft from any opening to the underground or any building directly connected with such opening and at least 300 ft from any explosives magazine. Such liquids when stored in buried tanks shall be placed at least 50 ft from any opening to the underground or any building directly connected with such opening and at least 300 ft from any explosives magazine.

7-13.3. Storage of Lubricating and Other Combustible Oils

Lubricating or other combustible oils shall be stored at least 50 ft from any opening to underground or from any building directly connected with such opening and at least 300 ft from any explosives magazine.

7-13.4. Barriers

All places used for the storage of flammable liquid fuel or lubricating or other combustible oils shall be so situated or so provided with barriers having enough capacity to hold the entire contents of liquid and prevent it from flowing to within 100 ft of any mine opening or 300 ft of any explosives magazine.

7-13.5. Tank Vents

Tanks buried underground in which flammable liquids or lubricating oils are stored shall be properly vented.

7-13.6. Storage Buildings

Buildings used for the storage of flammable liquids shall be used for no other purpose, and shall be clearly marked by signs identifying their contents. Such buildings shall be of fire-resistive construction.

7-13.7. Flammable Liquids Underground

Flammable Liquids Underground shall not be stored underground in any mine, provided, however, that such flammable liquid, not exceeding one day's supply for each power unit, may be kept in a tank attached to the unit.

7-13.8. Lubricating or Other Combustible Oils Underground

Lubricating or other combustible oils, shall at no time exceed a 6 days' supply underground except as may otherwise be permitted by the Commissioner. Such oils when stored underground, shall be stored in a fire-resistive structure.

7-13.9. Transportation

In the transportation of flammable liquids, no person shall be permitted to ride on the skip or other conveyances with such liquids, except the person transporting same.

7-17. HAULAGE AND HANDLING EQUIPMENT

MUCK TRAINS

7-17.13. Internal Combustion Engines

The use of internal combustion engines for underground haulage shall be subject to approval by the Commissioner.

CALIFORNIA

Contact:

State Mine Inspector
State of California
Department of Industrial Relations
Division of Industrial Safety
1390 Market St., Room 710
San Francisco, Calif. 94102
415/557-2405

Coal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground coal mines.

Metal and Nonmetal Mines

State of California, California Administrative Code, Title 8, Industrial Relations, Chapter 4. Division of Industrial Safety (Safety Orders), Subchapter 17. Mine Safety Orders.

(Register 72, No. 20--5-13-72)

Note: The Federal Metal and Nonmetallic Mine Safety and Health Regulations have been included with the Mine Safety Orders. The numbers indicated within the parentheses, such as (3-5), refer to the Standard found in the Federal Metal and Nonmetallic Mine Safety and Health Regulations. The Mine Safety Order number precedes the Federal number; for example, 6965. (3-5). Some State Safety Orders have no Federal reference number but all Federal Mandatory Standards are covered by State Safety

Orders. This arrangement will help the mine operators and their employees in complying with both the Federal and State Mine Safety Orders.

The Federal Mandatory Regulation "Part" numbers are not included in the Section numbers, but are listed here for your information:

Part 55--Open Pit Mining Operations
 Part 56--Sand, Gravel, and Crushed Stone Operations
 Part 57--Underground Mining Operations

The Mine Safety Orders are identified by headings such as--

"General"--Applies to both surface and underground mining operations.
 "Surface"--Applies to surface mining operations only.
 "Underground"--Applies to underground and surface facilities of underground mining operations.

Art. 22 FIRE PREVENTION AND CONTROL

General

7055. Fire Prevention and Control

- (i) (4-21) Equipment powered by internal combustion engines (except diesel engines) where the fuel tank is an integral part of the equipment, shall be shut off and stopped before being fueled.

Underground

7065. (4-54) Fuels, Lubricants, and Rope Dressings--Underground Storage and Handling

(a) Oils, greases, and rope dressings taken underground shall be transported and stored in closed metal containers that will not permit the contents to leak or spill.

(b) Rope dressings shall not be stored in the mine.

(c) The underground storage place for oils and greases shall be located in a remote place where there will be the least danger to men in the mine should a fire occur.

Where practical, the storage place shall be at least 25 ft from any timbers. Where it is necessary to store oils or greases nearer than this distance to mine timbers, such timbers shall be made fire resistant.

Should the amount of oil or grease stored on any one level exceed 60 gal, it shall be stored in a manner acceptable to the Division.

(d) The storage place shall be so arranged that the contents of leaking containers cannot run from the storage place.

(e) Adequate drip pans shall be provided at the storage places of oils, greases, and rope dressings.

(f) Leaking containers or fittings shall be promptly repaired or replaced.

(g) Spillage and leakage shall be promptly cleaned up and sent to the surface.

(h) No combustible materials shall be permitted in any oil or grease storage place.

(i) (4-52) Gasoline shall not be taken, stored, or used underground except in permissible flame safety lamps.

(j) (4-53) The use of liquefied petroleum gases shall be limited to maintenance work.

Art. 25 ENGINES--INTERNAL COMBUSTION

Underground

7068. Internal Combustion Engines Near Mine Openings

No internal combustion engine shall be permitted on the surface within 50 ft of any mine opening.

EXCEPTION: This does not apply to self-propelled vehicles which are not operated as stationary equipment.

7069. Engines Prohibited Underground

No fuel-burning or internal combustion engine, other than diesels as allowed in Section 7070 of these Orders, shall be permitted to operate in any mine.

7070. Permit to Use Diesel Engines Underground

(a) No diesel engine shall be permitted in an underground mine unless a permit to use diesel engines underground has first been secured from the Division of Industrial Safety.

(b) Application for such permit shall be made in writing to the Division of Industrial Safety, and shall include the following information:

- (1) Service for which diesel engines are intended.
- (2) Location in mine where engines are to be operated.
- (3) Aggregate brake horsepower of all diesel engines to be operated in the mine.
- (4) Plans for ventilation of the mine.
- (5) Any other information considered pertinent by the Division.

(c) When in the opinion of the Division diesel engines can be operated safely in the mine, a permit may be issued to the applicants specifying the conditions under which the diesel engines must be operated.

(d) When a permit is issued the conditions specified are those believed necessary for the protection of workers. If experience in the operation of the diesel engine indicated that any of the conditions are inadequate or unnecessary, the Division may revise the conditions in the light of such experience.

(e) The permit to use diesel engines underground may be revoked for failure to comply with conditions of the permit.

(f) The following is a list of conditions under which diesel-powered equipment will be permitted to operate in underground mines:

- (1) Before any diesel engine is permitted underground, the Employer shall make sure that it is in good operating condition.
- (2) Every diesel engine, which is operated underground, shall be checked daily by a mechanic who is skilled in the operation and maintenance of diesel engines. The diesels shall be maintained in good operating condition.
- (3) The exhaust of each diesel shall be passed through a water bath or approved catalytic conditioner prior to its discharge into the atmosphere. Conditioners shall be kept in proper operating condition at all times when equipment is in use underground.
- (4) Diesel exhaust gas shall not be directed towards diesel operators and shall be deflected so that persons alongside will not encounter exhaust gas at breathing level.
- (5) The diesel fuel shall not contain in excess of 0.5 pct of sulfur.
- (6) Each diesel unit shall be equipped with a fire extinguisher suitable for control of oil fires.
- (7) Before any diesel engine is permitted underground, the mine shall be provided with a mechanically produced and positively controlled system of ventilation.
- (8) The main fan shall be installed on the surface and shall be of a type that readily permits the air current to be reversed in direction.
- (9) A continuous flow of fresh air shall be maintained in the mine as long as any diesel equipment is operating therein.

- (10) The flow of fresh air in any air course shall never be less than 100 cu ft/min of air per brake horsepower of the aggregate diesel equipment operating in such air course, plus 200 cu ft/min of air for each employee therein.
- (11) Positive instructions shall be issued to all workmen that all diesel equipment underground shall be shut down immediately should the air flow stop, and shall remain shut down until the air flow is resumed.
- (12) A daily record shall be kept of the condition of the diesels and the amount of ventilation provided. The record shall show:
 - (A) Condition of each diesel engine
 - (B) Total horsepower of diesel equipment that operates in the mine
 - (C) Quantity of air flowing in the air course
 - (D) Locations at which the air measurements were taken in relation to position of the diesel engines
 - (E) Name and title of the person who made the measurements
- (13) The record shall be signed by the person who made the measurements. A signed copy shall be kept in the office at the mine, and this copy shall be available for inspection by engineers of the Division of Industrial Safety.
- (14) Daily air quality tests shall be conducted for nitrogen dioxide and carbon monoxide. Results of such tests shall be kept with the daily diesel engine records. Diesels shall be shut down or ventilation increased if contaminant levels exceed safe threshold limit values.

7071. Fueling Diesel Engines Underground

- (a) Diesel engines shall not be fueled underground where it is practical to fuel them on the surface.
- (b) When fueled underground the engine shall be taken to the fuel storage place, if practical, and the fuel pumped directly from the storage container to the engine fuel tank.
- (c) (4-54) When the engine must be fueled away from the fuel storage place, the fuel shall be transported in closed metal containers that will not permit the contents to leak or spill should the container be overturned.
- (d) The engine shall be shut down during fueling operations.
- (e) Precautions shall be taken to prevent spilling during fueling operations. Spilled fuel shall be promptly cleaned up and removed.
- (f) The use of compressed air to force fuel from a container is prohibited.

(g) (4-1) No fire, smoking, open lights, or other source of ignition shall be permitted near fueling operations.

Note: See Section 7065 for orders pertaining to storage of fuels and lubricants.

Art. 31 AIR QUALITY, RADIATION, AND VENTILATION

(Register 80, No. 3--1-19-80)
General

7090. Environmental Controls

(a) (5-1a) The exposure to airborne contaminants of a person working in a mine shall not exceed, on the basis of a time-weighted average, the threshold limit values adopted by the American Conference of Governmental Industrial Hygienists, as set forth and explained in the most recent edition of the Conference's publication entitled "Threshold Limit Values of Airborne Contaminants." Excursions above listed threshold limit values shall not be of a greater magnitude than is characterized as permissible by the Conference. This paragraph (a) does not apply to airborne contaminants given a "C" designation by the Conference, for example, nitrogen dioxide.

(b) (5-1b) Employees shall be withdrawn from areas in which there is a concentration of an airborne contaminant given a "C" designation by the Conference which exceeds the threshold limit value (ceiling "C" limit) listed for that contaminant.

(c) General Industry Safety Orders for control of dust, fumes, mists, vapors, and gases shall be minimum standards for mines.

(d) (5-2) Dust, gas mist, and fume surveys shall be conducted as frequently as necessary to determine the adequacy of control measures.

(e) (5-5) Respirators shall not be substituted for environmental control measures. However, where environmental controls have not been developed or when necessary by nature of the work involved (for example, welding, sandblasting, lead burning), a person may work for reasonable periods of time in concentrations of airborne contaminants which exceed ceiling "C" limits or the limit of permissible excursions referred to in paragraph (a) and (b), if such person wears a respiratory protective device approved by the Bureau of Mines as protection against the particular hazards involved.

(f) (20-5) Carbon tetrachloride shall not be used unless under strict environmental controls.

(Register 72, No. 20--5-13-72)

UNDERGROUND MINE VENTILATION

7098. Ventilation

(e) Men shall not be permitted, except in extreme emergencies, to work in a place where the oxygen content of the air is less than 19.5 vol-pct (dry basis).

Subchapter 20. TUNNEL SAFETY ORDERS

(Register 73, No. 34--8-25-73)

Art. 12 VENTILATION AND DUST CONTROL

8437. Ventilation

(d) Men shall not be permitted, except in extreme emergencies, to work in a place where the oxygen content of the air is less than 20 vol-pct (dry basis), unless they are wearing permissible self-contained oxygen breathing apparatus.

(h) See Safety Order 8470 for diesel engine ventilation requirements.

Art. 17 TRANSPORTATION AND HAULAGE

8470. Fuel-Burning Internal Combustion Engines

(a) The use of fuel-burning or internal combustion engines or locomotives underground is prohibited, except for diesel engines when and where permitted in writing by the Division and under conditions specified for each project.

(b) Requests for such a permit shall be made in duplicate to the Division of Industrial Safety. The letter of request shall give detailed information regarding the proposed use, similar to the following:

- (1) Complete details and specifications of diesel engine and scrubbers
- (2) Location of tunnel and details of operation in which it is proposed to use the diesel equipment
- (3) Length, cross section and layout of tunnel
- (4) Maximum number and brake horsepower of diesels to be operated in any air course

- (5) Ventilation plan including direction of air flow, fan capacity, duct size, and auxiliary ventilation
- (6) Date when proposed diesel use is to begin and dates and locations where representatives of the Division of Industrial Safety may make tests of the diesel's exhaust gases.

(c) The request shall also indicate the ways in which the following standards will be met:

- (1) The fresh air reaching the area where diesels are operating is to flow constantly in one direction and shall amount to at least 100 cu ft/min per diesel brake horsepower plus 200 cu ft/min per man.
- (2) Testing devices for nitrogen dioxide and carbon monoxide shall be provided and used in the tunnel at least once each shift at the peak of diesel operation and a written record kept of readings. Tests shall be conducted by qualified persons trained in the use of testing devices.

Note 1: Nitrogen dioxide is the most harmful of the gases discharged by diesel equipment. If it is held within the specified limits by adequate ventilation, the carbon monoxide resulting from diesel operations will normally be well below harmful levels.

Note 2: Permissible Maximum Amounts of Noxious Gases

- (A) Carbon Monoxide 20 ppm (0.002 pct) in the general tunnel atmosphere under average working conditions.
 - (B) Nitrogen Dioxide 5 ppm (0.0005 pct) in the general tunnel atmosphere.
 - (C) Formaldehyde 5 ppm (0.005 pct) in the general tunnel atmosphere.
- (3) The exhaust from the diesel engine shall be passed through an acceptable scrubber that is at least as effective as a well-designed water-bath scrubber in reducing hazard and discomfort to workers.
 - (4) The diesel engine and scrubber shall be maintained in good mechanical condition and proper working order. Scrubbers shall have inspection openings so that the internal condition and/or water level can be determined.
 - (5) The diesel fuel used shall not contain over 0.35 pct sulfur by weight.
 - (6) The diesel fuel supply shall not be stored or taken into the tunnel in amounts greater than required for eight hours of operation.

(d) Permits may be revoked for failure to abide by specified conditions, or failure to comply with Order 8470.

Appendix B.-- Labor Code Excerpts

Division 5, Safety in Employment

Part 1. Workmen's Safety

Chapter 2. Gassy and Extrahazardous Tunnels

7979. In tunnels or underground mines classified extrahazardous, sufficient air shall be supplied to maintain an atmosphere of all of the following conditions:

- (a) Not less than 19 pct oxygen.
- (b) Not more than 0.5 pct carbon dioxide.
- (c) Not more than 5 ppm nitrogen dioxide.
- (d) No petroleum vapors or other toxic gases in concentrations exceeding the threshold limit values established annually by the American Conference of Governmental Industrial Hygienists.

7980. All electrical equipment and machines, including diesel engines, used in tunnels or underground mines classified extrahazardous shall be permissible equipment. The division may, however, permit the use of nonpermissible equipment in a tunnel or underground mine in areas where it finds there is no longer danger from gas or other hazards.

COLORADO

Contact:

State Mine Inspection
State of Colorado
1313 Sherman St.
Denver, Colo. 80203
303/839-3401

Coal Mines

Coal Mining Laws, State of Colorado, 1973.

Art. 24 VENTILATION

34-25-105 Quality of Air

Air in which men work or travel in mines shall be improved when it contains less than 19.5 pct oxygen, or is contaminated with noxious or poisonous gases.

Art. 29 SAFETY REGULATIONS

34-29-112 Haulage Equipment

Nonpermissible internal combustion engines or other machinery which gives off noxious fumes in dangerous quantities shall not be permitted in any underground mine.

Metal and Nonmetal Mines

State of Colorado Statute Number 3440-101, Creation of the Bureau of Mines--1895.

43. Diesel Equipment

1. These rules apply to the operation of diesel-powered equipment used underground in all metal mines, reclamation tunnels, clay mines, tunnel projects, or any underground mining operation except coal mines. Only Bureau of Mines approved diesel equipment is allowed underground.
2. A permit must be secured from the Bureau of Mines for the operation of diesel-powered equipment underground before the equipment is taken underground. A 10-day verbal temporary permit may be granted by the District Metal Mining Inspector during the time a formal application is pending.
3. Diesel equipment used underground must be maintained in top operating condition at all times. The same will be removed from underground by the inspector when the diesel equipment is found to be in poor operating condition and producing an excessive amount of toxic gases.
4. Mine ventilation must be designed so that diesel exhaust gases will not accumulate in or be transported to areas of poor ventilation. All gas-laden air must be exhausted to the surface by the most direct route.
5. A fuel-air ratio adjustment, calculated to produce a minimum of toxic exhaust gases, will be required as set forth in U.S. Bureau of Mines Report of Investigations 4287.
6. All diesel engines used underground must be fitted with exhaust gas conditioners or scrubbers which are connected to the diesel exhaust manifolds with leak-proof fittings. These scrubbers must be connected at all times when the equipment is underground.
 - (a) Units of 150 horsepower or less and units operating in small bores or areas of less than 400 sq ft cross section or where the ground is supported by combustible material shall be equipped with scrubbers or conditioners which operate on the water-wash principle. These scrubber units must be so constructed that they can contain and maintain sufficient water to wash exhaust gases for a period of no less than four hours under normal operating conditions. The scrubber water, if reused, must be drained and the scrubber refilled at periods not exceeding four hours of operation.
 - (b) Exhaust gases discharged from water-wash scrubbers shall not exceed a temperature of 180° F.
 - (c) Scrubbers must be so constructed that exhaust pressure will not push solid water from the scrubber.

- (d) Diesel units of less than 150 horsepower are not allowed to operate underground with a dry scrubber, or with a scrubber that does not hold the exhaust temperature to maximum of 180° F.
 - (e) Exhaust conditioners or scrubbers are to be cleaned and completely checked and serviced at least once each week.
 - (f) Catalyst or dry scrubbers or exhaust conditioners may be used on units larger than 150 horsepower which are in continuous operation while underground.
 - (g) Exhaust gases from a dry conditioner must not be released less than five ft from the walls, roof, back or floor of underground workings, nor less than five ft from any timber or combustible material in such underground workings.
 - (h) Exhaust gases from a dry conditioner must be diluted and diffused into the atmosphere by baffles, screens or venturi-type dilution.
 - (i) Dry scrubbers must not be regenerated underground.
 - (j) Dry scrubbers cannot be used underground when explosive gases are present in excess of 0.5 pct.
 - (k) Scrubbers or conditioners shall be constructed so as not to excessively increase exhaust back pressure when the diesel is developing its rated horsepower.
7. Fresh air ventilation must be supplied to the immediate area in which the diesel is operating at a rate not less than 75 cu ft/min for each brake horsepower being used in the area. This is in addition to the normal ventilation required for each man working in the area.
8. Diesels will be removed from underground when the atmosphere contains toxic gases above the tolerance set by the U.S. Bureau of Mines and the State Health Department as listed below:
- | | |
|--------------------|-----------------------|
| Carbon dioxide | 0.5 vol-pct |
| Carbon monoxide | .005 vol-pct, 50 ppm |
| Oxides of nitrogen | .0025 vol-pct |
| Nitrogen dioxide | .00005 vol-pct, 5 ppm |
| Aldehydes | .001 vol-pct |
| Oxygen | Less than 30 vol-pct |
| Methane | .5 vol-pct |
9. Mine areas in which diesel engines are operating will be tested for toxic atmosphere at frequent intervals by a representative of the Bureau of Mines.
10. Permits are not transferable from one operator to another or from one property to another.

11. At no time will more horsepower be allowed underground than is stated on the permit.
12. Violation of any of the above rules will be cause for permit cancellation.

71. Gases

- 57.5-2
1. When the atmosphere in any mine, or part of the mine, is known to contain or is suspected of containing any explosive or toxic gas, it shall be tested by approved means before employees are allowed to work therein.
 2. Tests shall be made by an employee designated by the employer as competent to make such tests.
 3. Hazardous gas or vapor conditions shall be deemed to exist when the place of employment contains higher concentration limits than shown in the following table:

Gases and Vapors

<u>Name</u>	<u>Parts of Million</u>
Ammonia	50
Benzene	25
Carbon dioxide	5,000
Carbon monoxide	50 (0.005 vol-pct)
Chlorine	1
Gasoline	500
Hydrogen cyanide	10
Hydrogen sulphide	10
Methane	500 (0.5 vol-pct)
Naptha (petroleum)	100
Nitrogen dioxide	5
Nitrogen oxides	25

4. The maximum allowable concentrations of gases and vapors are according to standards set forth in Rules and Regulations pertaining to Occupational Health, Colorado Department of Health, as follows:

OH 2.8 Permissible Atmospheric Concentrations (Threshold Limit Value)

- 1) The acceptability of the concentration of atmospheric contaminants in the air breathed by workmen shall be governed by the latest revised document pertaining to Threshold Limit Values as prepared by the American Conference of Governmental Industrial Hygienists.

- 2) It is not implied that observance of the Threshold Limit Values will be a guarantee against possible ill health of workers exposed, or that medical control can be neglected.

72. Gasoline

- 57.4-52 1. Equipment powered by gasoline or equipment powered by butane or propane gas shall not be used in any underground mine, excavation or quarry.

CONNECTICUT

Contact: Connecticut Department of Labor
200 Folly Brook Blvd.
Wethersfield, Conn. 06109
203/566-5123

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Connecticut presently has no underground mines.

DELAWARE

Contact: Delaware Geological Survey
10 Penny Hall
Newark, Del. 19711
302/738-2833

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Delaware presently has no underground mines.

FLORIDA

Contact: Bureau of Geology
Florida Department of Natural Resources
903 West Tennessee St.
Tallahassee, Fla. 32304
904/488-4191

Coal, Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Florida presently has no underground mines.

GEORGIA

Contact: Georgia Department of Natural Resources
Environmental Protection Division
270 Washington St. SW
Atlanta, Ga. 30334
912/744-3346

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Georgia has adopted Federal Underground mining regulations for coal, metal, and nonmetal mines.

HAWAII

Contact: State of Hawaii
Department of Labor and Industrial Relations
Division of Occupational Safety and Health
677 Ala Moana, Suite 910
Honolulu, Hawaii 96809
808/548-4155

State Mineral Specialist
U.S. Bureau of Mines
Western Field Operation Center
State Mineral Information Programs
315 East Montgomery
Spokane, Wash. 99207
509/439-6880

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Hawaii presently has no underground mines.

IDAHO

Contact: Department of Labor and Industrial Services
317 Main St.
Statehouse Room 400
Boise, Idaho 83720
208/334-3400

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Idaho has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

ILLINOIS

Contact: State Department of Mines and Minerals
 State Office Building, Room 704
 Springfield, Ill. 82706
 217/782-6791

Coal Mines

The use of internal combustion engines in the State of Illinois in underground coal mines is prohibited by State laws.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines. Illinois has adopted Federal underground mining regulations for metal and nonmetal mines.

INDIANA

Contact: Commission of Labor
 Indianapolis, Ind. 46204
 317/232-2663

Director
 State Department of Mines and Minerals
 Indiana Bureau of Mines and Mining
 125 South 15th St.
 Terre Haute, Ind. 47807
 812/232-6406

Coal Mines

Coal Mining Laws of Indiana, Indiana Code 22-10, effective September 1, 1979.

Application of Act--Gasoline Engines

IC 22-10-27, Section 13

The provisions of this act shall apply to all commercial coal mines, except that it shall be unlawful to use or operate any gasoline propelled engine or machinery inside any mine in this state.

Safety and Protection of Employees

Combustion Propelled Engines--Use
 Unlawful-when-IC 22-10-2-8, Section 14

It shall be unlawful for any owner or operator of a coal mine who is engaged in removing any material or product from under the surface of the

earth to use or operate any combustion propelled engines or machinery in any such operation underneath the ground when employees are engaged at work.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines. Indiana has adopted Federal underground mining regulations for metal and nonmetal mines.

IOWA

Contact: Department of Soil Conservation
Mines and Minerals Division
Wallace State Office Building
Des Moines, Iowa 50219
515/281-5774

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Iowa presently has no underground mines.

KANSAS

Contact: Department of Human Resources
Division of Industrial Safety
401 Topeka Ave.
Topeka, Kans. 66603
913/296-5000

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Kansas has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

KENTUCKY

Contact: Kentucky Department of Labor
Capitol Plaza
Frankfort, Ky. 40601
502/564-3019

Coal and Clay Mines

Operation and Maintenance of Mobile Powered Transportation Equipment in Underground Coal Mines.

Pursuant to the authority of KRS 352.050(1), 351.021, 351.070(11), (12)

1.01: General Requirements

- (a) Only diesel equipment bearing approval plates of permissibility issued by the U.S. Bureau of Mines and approved for use by the Kentucky Department of Mines and Minerals will be allowed in underground coal mines of the State. No diesel-powered machinery may be taken into any underground coal mine of the State of Kentucky without the written approval of the Commissioner of Mines and Minerals. The approval for use shall incorporate all the requirements of these regulations. If at any time the Commissioner determines that any condition or practice permitted under this approval may threaten the health or safety of the employees, he may impose additional requirements for the purpose of eliminating the condition or practice.
- (b) If technical, scientific or engineering information is gained indicating that approved diesel machinery may be used in a manner which will afford the workmen equal or greater protection than afforded by the provisions of these regulations, the Commissioner may approve the use of the machinery in the manner which provide equal or greater protection.
- (c) Bureau of Mines approval of the permissibility of Mobile diesel-powered transportation equipment (hereinafter referred to as diesel machine(s)) means only that the particular machine has met certain specific requirements of design and performance, but such approval does not guarantee that it is impossible to use a permissible machine in an unsafe manner. The manufacturer must develop equipment that will meet the particular requirements for approval, but it is the user's responsibility to see that the equipment is maintained in permissible condition and is used in a permissible manner.

In addition to proper maintenance, the use of diesel machines underground involves certain other factors, such as ventilation, which are of equal importance in establishing safe operating conditions. It is absolutely essential to observe the requirements of these regulations in operating and maintaining such machines to avoid impairing their permissible status and thus defeat the protective features that are necessary for their safe use.

- (d) Engine adjustments shall be verified by the manufacturer as being correct before each permissible diesel machine is operated in a coal mine.
- (e) Alteration in design, substitution of components or subassemblies, or changes in conditions of operating permissible diesel machines shall not be made without prior concurrence of the Kentucky Department of Mines and Minerals and The Bureau of Mines. When such changes are permitted, additional engine tests and adjustment shall be required as necessary to insure the safe operation of the particular machine in a coal mine.

1.02: General Ventilation

- (a) The use of diesel machines underground shall be restricted to haulageways and working places where positive (controlled flow) ventilation is maintained.
- (b) The ventilating air in all mine workings where diesel machines are operated shall not contain combustible or other contaminating gases in such concentration that will affect combustion in the diesel engine by materially increasing production of toxic (poisonous) or other objectionable constituents in the engine exhaust.
- (c) Each set of producing entries in which diesel-powered equipment is used shall be placed on a separate split of air.

1.03: Quantity of Ventilating Air

- (a) In addition to the amount of air required by the Kentucky Mining Law, at least 6,000 cu ft/min of air shall be provided for each diesel unit used in a working section of a mine. The air measurement shall be taken in the last open entry crosscut. If these locations cannot be used due to pillaring, the measurements shall be adequate to dilute the toxic and/or objectionable constituents of the engine exhaust so that the composition of the air in each haulageway and working place connected thereto will meet authoritative standards for safe, healthful working environment.
- (b) The minimum quantity of ventilating air that must be supplied for a permissible diesel machine in a given time shall conform to that shown on the approval plate attached to the particular machine.
- (c) The quantity of ventilating air in mine workings where diesel machines are operated shall be measured once during each working shift and a record of each measurement shall be kept in a book provided for this purpose.
- (d) No person shall incorporate any device in the exhaust system of a permissible diesel machine that has not been approved in the tests that determine the permissibility of the machine.

1.04: Quality of Ventilating Air

- (a) The air supplied for ventilation where diesel machines are used in coal mines shall contain not less than 20.5 vol-pct of oxygen (dry basis) and not more than 1.0 vol-pct of methane.
- (b) The ventilating air in working places where diesel machines are operated shall be sampled and analyzed chemically often enough to assure that the composition of the engine intake air conforms with the requirements stated in paragraph (a) of this section, and that the concentrations of contaminants, such as carbon dioxide, carbon monoxide, and oxides of nitrogen, when added to the ventilating air

by the diesel engine exhaust shall meet authoritative standards for safe, healthful working environment.

- (c) Ventilation and machine-operating conditions shall maintain the composition of the air in the pertinent mine workings so that the tolerable limits stated in paragraphs (a) and (b) of this section will not be exceeded.
- (d) Diesel engine exhaust shall not contain black smoke.
- (e) When the conditions of the quality of air stated in paragraphs (a), (b), and (c) of this section are not maintained, as determined by analysis or other observation, operation of diesel machines shall be stopped until the requirements of air quality are complied with.
- (f) Records shall be kept of all air analyses and of any change(s) in ventilation or diesel engine adjustment resulting from the analyses.

1.05: General Maintenance

- (a) The maintenance of diesel machines in permissible condition shall be delegated only to authorized, competent persons.
- (b) Engine intake and exhaust systems shall be inspected visually at least once each working shift. Other diesel machine components shall be inspected in accordance with instructions of the manufacturer. Records shall be kept of maintenance, inspection and repair work.

1.06: Maintenance of Engine-Fuel-Injection System

- (a) Injection valves.
 - 1. Injection valves shall be maintained in proper operating condition. Particular attention shall be given to preventing imperfect atomization or distribution of the fuel.
 - 2. Replacements of worn or broken injection valves shall be identical with those on the engine when the diesel machine was approved as permissible.
- (b) Fuel pump.
 - 1. The engine fuel pump shall be sealed or locked to prevent tampering. The seal shall be broken only by an authorized competent person, when necessary to reset the fuel pump, after which the pump shall be resealed.
 - 2. Resetting of the stop limiting maximum fuel injection of the fuel pump shall be identical with the original setting provided by the manufacturer.

3. Each shop or facility in which diesel engines are serviced shall be provided with equipment for properly measuring the quantity of fuel delivered by the fuel pump when operating at maximum fuel setting, or such adjustments shall be made only by a competent diesel service organization where such equipment is available.
4. The fuel pump shall be set to deliver the maximum weight of fuel specified in the certifications provided by the U.S. Bureau of Mines and the Kentucky Department of Mines and Minerals.
5. When operating a diesel engine at altitudes exceeding 1,000 feet above sea level, the maximum quantity of fuel injected by the fuel pump shall be set in accordance with the liquid fuel rate/altitude table provided in the manufacturer's caution statement.

1.07: Inspection and Maintenance of Engine-Intake System

- (a) The engine-intake system, including flame arrester(s), air cleaner, and all joints, shall be inspected at intervals according to the manufacturer's general maintenance instructions.
- (b) Inspection of the engine-intake system shall include tightness of all joints and cleanliness of flame-arrester surfaces.
- (c) Periodic measurements shall be made of the vacuum in the engine intake system to determine whether the air cleaner and flame arrester(s) require cleaning.
- (d) The air cleaner of the engine-intake system shall be maintained in accordance with the manufacturer's instructions. The normal oil filling level shall not be exceeded.

1.08: Inspection and Maintenance of Engine-Exhaust System

- (a) The engine-exhaust system, including flame arrester(s), conditioner or cooling boxes, shut-off mechanism, water spray, and exhaust-dilution system, shall be inspected at intervals according to the manufacturer's general maintenance instructions.
- (b) Periodic measurements shall be made of the positive pressure in the engine-exhaust system to determine whether the exhaust flame arrester requires cleaning.
- (c) The water supply for the exhaust gas cooling system shall be replenished by an authorized person at the beginning of each working shift.
- (d) When salts from evaporation of water in the exhaust-gas cooling system are deposited on auxiliaries, such as cooling boxes, conditioners, and other parts of the system, such auxiliaries shall be

flushed with water and cleaned to remove the salt deposits, as well as soot filtered from the exhaust gas.

- (e) Float valves shall be serviced at intervals according to the manufacturer's instruction to maintain them in good operating condition.
- (f) Functioning of the fuel shut-off mechanism, actuated by the exhaust gas temperature, shall be tested at least once every three months. This test shall be made in a safe place, not in active face workings of a coal mine.
- (g) All heated surfaces of the diesel engine shall be inspected and cleaned at intervals frequent enough to insure that such surfaces are kept free of combustible materials, such as coal dust, diesel fuel, lubricants, and rags or waste.
- (h) The exhaust-gas dilution system shall be inspected and cleaned at intervals frequent enough to insure safe dilution of the exhaust gas when it is discharged from the diesel engine (see 1.04).
- (i) Whenever the diesel engine exhaust is smoky or objectionable odors are emitted in the exhaust, the cause shall be investigated immediately and corrected in accordance with the manufacturer's instructions.

1.09: Electrical Equipment

- (a) Locks and seals. Electrical parts, such as battery boxes and headlights, shall be provided with locks and seals that are maintained where required to preserve the permissible status of a permissible diesel machine.
- (b) Fastenings. Joints in motor casings, starting-switch enclosures, headlights, and other parts that are subject to arcing during normal operation shall be fastened securely. All bolts, cap screws, and other means of joining parts of casings and enclosures shall be kept in their proper places and secured tightly.
- (c) Wiring and Conduit.
 1. Wiring insulation shall be maintained in good condition and when worn or abraded shall be replaced with well-insulated wiring.
 2. Rubber hose, steel pipe, and other types of conduit for wiring shall be supported firmly at each end and between ends when the lengths are such as to require additional support. Conduit and other means of protecting wiring shall be kept in place and maintained in condition equivalent to that provided by the manufacturer for the permissibility tests.

- (d) Headlight and instrument lenses. Lenses forming part of the explosion-proof easings of headlights or enclosures of instruments shall be securely in place. Cracked leses shall be replaced immediately.
- (e) Overload and short-circuit protection. Tampering with fuses, relays or other means supplied by the manufacturer for overload and short-circuit protection of wiring and electrical parts shall not be permitted, nor shall the use of substitutes that nullify such protection be permitted.
- (f) Battery. Battery-cell tops shall be maintained free of electrolyte and other foreign material. Connections between battery cells shall be kept tight and free of corrosion.

1.10: Fuel

(a) Specifications.

1. The fuel for diesel engines of machines approved for service in underground mines shall conform to the equipment manufacturer's specifications for viscosity, pour point, cetane number, carbon residue and water. The flash point shall be not less than 140° F, and sulfur contents shall not exceed 0.5 wt-pct.
2. Only distillate fuel shall be used in engines of permissible diesel-powered transportation equipment for underground mines.

(b) Storage and Handling

1. Fuel taken underground shall be transported only in strong, tight metal containers that are provided with efficient closing devices.
2. The quantity of fuel stored underground shall not exceed that required for 24 hours operation of all diesel machines in use.
3. Fuel taken underground and awaiting transfer to diesel machine fuel tanks shall be stored in a closed compartment, constructed of incombustible materials, and shall be kept in a well-ventilated location, the return air from which shall not pass through any active mine workings.
4. The walls of a fuel-storage compartment shall form a liquid tight joint with the bottom of the mine floor. Any openings in the fuel-storage compartment, such as a doorway, shall be provided with a sill high enough to form a catch-basin in the storage compartment to retain spilled fuel. The capacity of the catch-basin shall be large enough to hold the maximum quantity of fuel that is permitted to be stored underground.

5. Diesel machine fuel tanks shall be filled only at the fuel storage compartment. Fuel shall be transferred from the storage compartment to a machine fuel tank through a flexible hose that is fitted with a self-closing valve.
6. The fuel-handling system and the diesel machine shall be frame grounded when fuel is being transferred from the storage compartment to the machine fuel tank.
7. The air vents on fuel-handling equipment shall be flameproof.
8. When fuel is being transferred from the storage compartment to the machine fuel tank, the diesel engine shall be stopped.
9. A supply of sand or other suitable incombustible material shall be available during the transfer of fuel from the storage compartment of the machine fuel tank for absorbing spilled fuel.
10. All drain plugs in the fuel-handling system shall be threaded and sealed or locked in the closed position to prevent unintentional opening.
11. Only trained authorized persons shall be permitted to handle fuel for diesel machines.
12. In fuel-handling operations, precautions shall be observed to keep the fuel clean and free from contamination by foreign material, such as dirt, sediment and water.
13. Fuel filters on diesel engines shall be cleaned regularly and repaired promptly as conditions require.

1.11: Fire Extinguishers

Liquid carbon dioxide or pressurized dry-chemical fire extinguishers shall be installed at underground repair shops, machine barns, and fuel storage compartments.

1.12: Underground Repair Shops and Machine-Storage Barns

(a) Ventilation.

1. Underground repair shops and diesel machine storage barns shall be ventilated by a separate air split between the intake and return airways.
2. When diesel machines are operated in an underground repair shop or storage barn, or in the event of fire, arrangements shall be made to conduct the products of combustion therefrom directly to the return airway.

(b) Construction.

1. Underground repair shops and machine-storage barns shall be lined with nonabsorbent incombustible material. Doors or other means of closure shall be constructed of similar incombustible material.
 2. Floor of underground repair shops and machine-storage barns shall be impervious to oil and shall be so graded as to provide natural drainage to a sump or catch-basin to collect spilled oil.
 3. Spilled oil shall be cleaned up and removed from the sump or catch-basin promptly and stored in closed metal containers until disposed of on the surface.
- (c) Repair operations. Welding or other operations that might create a fire hazard shall not be done unless precautions are observed to prevent inadvertent ignition of diesel fuel or lubricants.
- (d) Miscellaneous. A supply of sand or other incombustible material shall be kept in underground repair shops and machine-storage barns to aid in fire-fighting and to absorb spilled diesel fuel or lubricants.

1.13: General

- (a) The operation of diesel equipment in underground coal mines in Kentucky shall be under the supervision of a foreman holding a First Class Certificate.
- (b) Not more than two diesel shuttle cars will be permitted to operate at the same time in a single air split. Provided, however, that the Commissioner of Mines and Minerals may, if he determines that the safety or health of the employees will not be jeopardized, permit additional shuttle cars to be used.
- (c) No diesel equipment will be permitted to operate in any section of a mine where room entries exceed 3,000 ft in depth.
- (d) The engine of a shuttle car shall be shut down at all times when not in use (that is, it must not be allowed to idle more than absolutely necessary).
- (e) If the engine exhaust becomes more noticeable than normal, the equipment shall be removed from the faces and shut down until the proper repairs can be made to correct this condition.
- (f) All employees working in sections where diesel equipment is used shall be furnished with self-rescue respirators which they shall carry at all times while on duty in the mine.

- (g) No person who works in close proximity to mobile diesel equipment throughout the shift shall be permitted to work more than a ten-hour continuous shift in any 24 hours.
- (h) Access to all company records such as maintenance, repairs, fuels, ventilation, etc., pertaining to the use of the underground diesel equipment shall be made available to representatives of the Kentucky Department of Mines and Minerals.
- (i) The operation of any diesel machine in any manner or under any condition that does not comply with the requirements of these regulations shall be considered by the Department as voiding its approval for underground use.
- (j) Terminology used in these regulations is consistent with that of Kentucky Revised Statutes 351.010 and 352.010 unless the context requires otherwise. (CM-Rg-1, effective 8/2/63).

LAWS GOVERNING THE MINING OF COAL AND CLAY, KENTUCKY REVISED STATUTES, CHAPTERS 351-352. Amended 1976.

Chapter 352: Mining Regulations

352.050 Regulations for underground machinery and locomotives; underground stables prohibited.

1. After June 6, 1972, no machinery powered by an internal combustion engine shall be placed in use in underground workings unless such equipment is rated "permissible" by the U.S. Bureau of Mines or the Mining Enforcement and Safety Administration for Underground Use and the use of the machinery is approved by the Commissioner of the Department of Mines and Minerals.
2. No steam locomotive shall be used in any mine where men are actually employed in the extraction of coal, but this shall not prevent the operation of a steam locomotive through any tunnel haulway and part of a mine which is not in actual operation and producing coal.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines, other than clay mines. Kentucky has adopted Federal underground mining regulations for metal and nonmetal mines.

LOUISIANA

Contact:

Director
 Department of Natural Resources
 Office of Conservation
 P.O. Box 44006--Capitol Station
 Baton Rouge, La. 70804
 504/342-5540

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Louisiana has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

MAINE

Contact:

Division of Industrial Safety
 Bureau of Labor
 Department of Manpower Affairs
 State Office Building
 Augusta, Maine 04333
 207/289-3331

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Maine presently has no underground mines.

MARYLAND

Contact:

Maryland Bureau of Mines
 City Building
 Westernport, Md. 21562
 301/359-3057

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Maryland has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

MASSACHUSETTS

Contact:

Department of Labor and Industry
 100 Cambridge St.
 Boston, Mass. 02202
 617/727-6155

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines.

Tunneling

Tunneling and use of diesel engines in tunneling is regulated by the State in Industrial Bulletin No. 7: Rules and Regulations for the Prevention of Accidents in Tunnels, Shafts, Subways, and Work Under Compressed Air (effective February 1, 1961).

Part 4. SAFETY PRECAUTIONS

J. Internal Combustion Engines

Internal combustion engines may be used underground if approved by the Commissioner.

Part 6. GENERAL

G. Ventilation

6. Men shall not be permitted, except in extreme emergencies, to work in a place where the oxygen content of the air is less than 19.5 vol-pct (dry basis).

J. Flammable Material

1. Oils and other dangerous flammable material shall be stored not less than 100 ft from any shaft or tunnel opening or building over tunnel opening and at least 100 ft from any powder magazine. Where oils are stored in buildings, such buildings shall not be used for any other purposes. Emergency water and fire lines shall be provided within 100 ft of shaft or tunnel opening. Tanks and drums containing flammable liquids shall be so located that the escaping liquid cannot run over the surface from such tank to any powder magazine or to any building within 100 ft of any tunnel opening. Under no circumstances shall oxygen or any flammable gas be stored in proximity of oil.
2. Open flame lights shall be prohibited at all places where gasoline, distillate, oil or other flammables are stored.
3. Lubricating oils, greases and rope dressings taken underground shall be in closed metal containers that will not permit the contents to leak out or spill. When taken underground, they shall be stored in a secluded place away from shafts, winzes, hoists, powder magazines and tunnel timbers in such manner that the oil from a ruptured or overturned container will not flow from its storage place.

6. The use of volatile solvents such as gasoline underground is forbidden except in small amounts such as is required for blow torches or miners' safety lamps.

Part 7. TRANSPORTATION AND HAULAGE

A. Fuel Burning Internal Combustion Engines

1. Diesel engines shall be of a type approved by the Commissioner.
2. The use of fuel burning or internal combustion engines or locomotives is prohibited, except for diesel engines and these shall be equipped with approved type "scrubbers" or filters.
3. Proper ventilation shall be provided to maintain a healthful work environment. (The fresh air reaching the area where any such diesel is operating is to flow constantly in one direction and should amount to at least 75 cu ft/min per diesel brake horsepower). The rate of dilution of the exhaust gases shall be 25-1.
4. Where explosive gases or dusts may be encountered, the intake and the exhaust openings of the engine shall be protected by flame arresters, and all flame passages or possible arc-producing parts shall be enclosed in explosion-proof housings.
5. All surfaces shall be maintained at temperatures below 400° F and other adequate precautions shall be observed to eliminate fire hazards.
6. Adequate regular maintenance shall be provided for haulage equipment in service.
7. Diesel fuel for underground use shall have a flash point of not less than 150° F and contain not over 0.5 pct sulphur by wt.
8. Diesel fuel supply shall not be stored or taken in the tunnel in amounts greater than required for one day's operation.
9. The exhaust for the diesel engine shall be passed through a scrubber to reduce the health hazard and discomfort to the workers. Scrubbers shall be serviced at least once every eight hours of operation.
10. The undiluted exhaust gases from the diesel shall not contain over 2,500 ppm of carbon monoxide.
11. The working atmosphere shall not contain over 100 ppm carbon monoxide, 2 ppm nitrogen dioxide, or sufficient aldehydes to cause undue irritation.

MICHIGAN

Contact:

Department of Labor
Bureau of Safety and Regulations
7150 Harris St.
Box 30015
Lansing, Mich. 48926
517/322-1814

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Michigan has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

MINNESOTA

Contact:

Minnesota Department of Labor and Industry
Occupational Safety and Health
Space Center Blvd.
444 Lafayette Rd.
St. Paul, Minn. 55101
612/296-2116

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Minnesota presently has no underground mines.

MISSISSIPPI

Contact: Mississippi Geological, Economic and Topographical Survey

Box 4915
Jackson, Miss. 39216
601/354-6228

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Mississippi presently has no underground mines.

MISSOURI

Contact:

Division of Mine Inspection
State of Missouri
Box 449
Jefferson City, Mo. 65101
314/751-3403

Coal, Metal, and Nonmetal Mines

Mine Inspection Laws of the State of Missouri, Chapter 293, October 1978.

Mine Inspection--General Provisions

293.120: Air safety requirements.--Air in which men work or travel in mines shall be improved when:

- (1) It contains less than 19.5 pct oxygen,
- (2) It contains more than 100 pct carbon monoxide,
- (3) It contains more than 0.5 pct carbon dioxide,
- (4) It contains more than 1 pct methane, or
- (5) It is contaminated with dust or with noxious or poisonous gases in excess of accepted limits as established by the director of the Division of Mine Inspection (L.1959 S.B. 188 Par. 13).

293.130: Mine railroad equipment and operating requirements--gasoline engines limited.

- (1) Gasoline engines shall not be used underground unless equipped with proper safeguards to prevent the emissions of gases that cause a contamination of the air beyond the limits set forth in Section 293.120.

REGULATIONS, TITLE 8, Department of Labor and Industrial Relations, Division 30, Division of Labor Standards.

Chapter 2: Mining Rules

30-2.020: Standard Practices for Safety and Operations

- (24) Internal combustion engines, except diesels, shall be shut off and stopped before being fueled.

Note: The State mining laws do not apply to limestone workings; gasoline-powered equipment is, accordingly, found in limestone mines.

MONTANA

Contact: Bureau of Safety and Health
815 Front St.
Helena, Mon. 59601
406/449-3403

50-46.71 Nonpermissible Internal Combustion Engines

Nonpermissible internal combustion engines or other machinery which gives off noxious fumes may not be permitted underground in any coal mine.

Metal and Nonmetal Mines

Montana Safety and Health Standards for Metal and Nonmetallic Mining and Related Industries, January 1972.

MT 57.4 Fire Prevention

MT57.4-52 Mandatory

Gasoline shall not be taken, stored, or used underground except in permissible flame safety lamps.

MT57.53 Mandatory

The use of liquefied petroleum gases shall be limited to maintenance work.

MT57.4-54 Mandatory

Oil, grease, or diesel fuel stored underground shall be kept in suitable tightly sealed containers in fire-resistant areas, at safe distances from explosives magazines, electrical installations and shaft stations.

MT57.21 Gassy Mines

Equipment

MT57.21-76 Mandatory

Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face and rib.

NEBRASKA

Contact:

Nebraska Department of Labor
Division of Safety
5404 Cedar St.
Omaha, Nebr. 68106
402/475-8451
402/471-2239

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Nebraska presently has no underground mines.

NEVADA

Contact:

Nevada Industrial Commission
515 East Musser St.
Carson City, Nev. 89714
702/885-5243

Coal, Metal and Nonmetal Mines

State of Nevada Health and Safety Standards.

Part 1: Open Pit or Underground Metal and Nonmetallic Mines and Sand, Gravel and Crushed Stone Operations, August 1975.

5. Air Quality, Ventilation and Radiation

Air Quality

5-a Mandatory

The operator of every mine, whether operated by shaft, stope or drift, shall provide and maintain for every such mine a good and sufficient amount of ventilation for such men as may be employed therein and shall cause an adequate amount of pure air to circulate through and into all shafts, winzes, levels, and all working places of such mine.

5-b Mandatory

Atmospheres where persons work (including equipment cabs) shall contain:

- (1) at least 20 pct oxygen,
- (2) not more than 0.0005 pct carbon monoxide, 0.5 pct carbon dioxide, and 5 ppm nitrogen dioxide or other threshold limit values for these gases adopted by the American Conference of Governmental Industrial Hygienists,
- (3) no harmful quantities of other gases, fumes, or mists as determined by threshold limit values established by the American Conference of Governmental Industrial Hygienists.

5-f Mandatory

- (1) Internal combustion engines shall not be used underground unless, after application filed with the Inspector of Mines, he finds that the particular type of equipment for the use of which application if (sic) filed has been approved for underground work by the U.S. Bureau of Mines, and the atmospheric conditions in the underground workings where the equipment is to be used are such that the operation of such equipment will not endanger the health or safety of any employee.

- (2) If the application to use an internal combustion engine underground be approved by the Inspector of Mines, the designated equipment shall be used only if and so long as it is operated and maintained in accordance with recommendations made public from time to time by the U.S. Bureau of Mines, and only upon the condition that whenever safe conditions of air quality are not maintained, operation of the equipment shall be stopped by the operator until proper conditions of air quality are again established, either by increasing ventilation or by correcting mechanical imperfections in the equipment, whichever is found to be the cause of the undesirable conditions.

Part 7: Underground Metal and Nonmetal Mines.

4. Fire Prevention and Control

4-21 Mandatory

Equipment powered by internal combustion engines (except diesel engines), where the fuel tank is an integral part of the equipment, shall be shut off and stopped before being fueled.

4-46 Mandatory

Gasoline, diesel fuel, liquefied petroleum gases, and other flammable liquids, when not buried, shall not be stored within 100 ft of the following:

- (a) Mine openings
- (b) Buildings or snowsheds connected to mine openings
- (c) Fan installations or housings
- (d) Hoist houses

4-52 Mandatory

Gasoline shall not be stored underground, but may be used only to power internal combustion engines in non-gassy mines that have multiple horizontal or inclined roadways from the surface large enough to accommodate vehicular traffic. Roadways and other openings shall be connected with another opening every 100 ft by a passage large enough to accommodate any vehicle in the mine.

4-54 Mandatory

Oil, grease, or diesel fuel stored underground shall be kept in suitable tightly sealed containers in fire-resistant area, at safe distances from explosives magazines, electrical installations, and shaft stations.

19. Man Hoisting
Hoists

19.13 Mandatory

When any diesel or similar fuel-injection engine is used to power a hoist, the engine shall be equipped with a damper or other cut-off in its air intake system. The control handle shall be clearly labeled to indicate that its intended function is for emergency stopping only.

21. Gassy Mines
Equipment

21.76 Mandatory

Diesel-powered equipment shall not be taken into, or operated in, places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face, and rib.

NEW HAMPSHIRE

Contact:

Director
Department of Resources and Economic Development
Forest and Lands
Box 856
Concord, N.H. 03301
603/271-2214

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. New Hampshire presently has no underground mines.

NEW JERSEY

Contact:

Bureau of Engineering and Safety
Box 2191
Trenton, N.J. 08625
609/292-2121

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. New Jersey has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

NEW MEXICO

Contact:

State Mine Inspector
State of New Mexico
2340 Manual NE, Suite 106
Albuquerque, N.M. 87107
505/842-3055

Coal, Metal, and Nonmetal Mines

New Mexico Mine Safety code for all mines including open cut and open pit.

Article 14: Ventilation and Gases in Coal Mines

63-14-15. Air Unfit for Working--Determination

The air in any unsealed place shall be considered unfit for human beings if it shall be found to contain less than 19 pct oxygen, more than 1 pct carbon dioxide or a harmful amount of poisonous gas, and mine workers shall be prohibited from working in such place except for the purpose of rendering it safe and fit.
(57.21-26M)

Rules Governing Diesel Equipment in Underground Mines for the State of New Mexico.

1. Diesel-powered equipment shall be equipped with a stainless steel exhaust gas conditioner which will reduce toxic gases to a minimum before they are released into the mine atmosphere. (Except that if limestone and water are used, scrubber may be of carbon steel.)
2. The use of diesel-powered equipment shall be restricted to haulage or other working places where positive ventilation is maintained by mechanical means.
3. If possible, the ventilation in places where diesel equipment is used shall be arranged so that the air carrying exhaust gases from the engine is returned to the main return airways without traversing active working places.
4. The quantity of ventilating air supplied must be adequate to dilute all toxic gases of engine exhaust.
 - (b) At least 75 cu ft/min of fresh air must be supplied per brake horsepower developed at a maximum rated speed and maximum load by diesel engine. This amount is in addition to the amount required for normal ventilation.

5. The air supplied for ventilation in connection with the use of diesel equipment underground should contain at least 20 pct oxygen, less than 0.25 pct inflammable gas, and less than 0.5 pct carbon dioxide. (57.21-76M)
6. The air of places in which diesel-powered equipment is used shall be examined at frequent intervals to determine that the composition of intake air is within the limits given in Rule No. 5, and the concentration of other contaminants, such as CO_2 , CO, NO_2 , added to the air by the equipment, is within the safe limits.

According to the U.S. Bureau of Mines, concentration of gases considered permissible in working areas are as follows:

CO_2 not more than 0.5 vol-pct
CO not more than 0.005 vol-pct or 50 ppm
 NO_2 not more than 0.0005 vol-pct or 5 ppm
 O_2 not less than 20 vol-pct

Aldehydes and smoke are self-evident if present in objectionable quantities and need not be determined by analysis.

7. Diesel engines of equipment shall be equipped with battery-powered starters rather than gasoline. Gasoline underground presents a fire hazard and is, of course, highly explosive.
8. A CO_2 fire extinguisher shall be carried at all times with each diesel-powered equipment.
9. A suitable carbon monoxide (CO) tester shall be provided and all diesel units shall be tested for CO at frequent intervals. Tests shall be made by a competent person and the results of tests recorded.
10. From observation and numerous tests made, if solution used in a gas conditioner consists of sodium sulfite, hydroquinine, and water, this solution must be changed at the end of eight hours of actual operation. If mineral briquets are used in a gas conditioner, the conditioner must be serviced once each week, the water changed, and a complete inspection made. A written report of conditions should be made and kept.
11. The conditioner must so treat the exhaust gas so that when it issues into the mine atmosphere the temperature will not exceed 180°F .
12. Before being placed in use underground, each diesel unit must be inspected and approved by the state inspector of mines, or a deputy state inspector of mines.

NEW YORK

Contact:

State of New York
Department of Labor
Division of Safety and Health
Room 111, Building 12
State Office Building Campus
Albany, N.Y. 12240
518/457-2810

Coal, Metal, and Nonmetal Mines

Underground Mining Operations: Part 31 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (cited as 12 NYC RR 31), May 1, 1974.

31.3 General Provisions

(v) Internal Combustion Engines

Internal combustion engines shall not be used underground unless such is acceptable to the commissioner.

31.14 Fire Prevention and Control

(b) Restriction of Ignition Sources

5. Fueling of vehicles. Vehicles with internal combustion engines, except diesel engines, shall be shut off and stopped before being fueled.

31.18 Personnel Hoisting

(b) Hoists

10. Diesel-powered hoists emergency stopping. Every diesel or similar fuel-injection engine used to power a personnel hoist shall be equipped with a damper or other cut-off device in its air intake system. The control handle for such damper or cut-off device shall be clearly labeled to indicate that its intended function is for emergency stopping only. (Effective Sept. 1, 1975)

31.23 Gassy Mines

(e) Equipment

1. General

- (i) Only permissible equipment maintained in permissible condition shall be used beyond the last open crosscut or in places where dangerous quantities of flammable gas may be present or may enter the air current.

2. Diesel-powered equipment. Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face and rib.

NORTH CAROLINA

Contact:

Mine and Quarry Division
North Carolina Department of Labor
Raleigh, N.C. 27407
919/733-7428

Coal, Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. North Carolina has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

NORTH DAKOTA

Contact:

Workmen's Compensation Bureau
Russel Bldg., Highway 83 North
Bismarck, N. Dak. 58501
701/224-2700

Coal, Metal, and Nonmetal Mines

Surface Coal Mine Safety Rules for North Dakota Mines, November 18, 1971.

M.11 General

- M.11.2 All motor vehicles and equipment shall be shut down with ignition off prior to and during refueling operations, except on diesel equipment having the fuel tank remotely located with respect to the engine. No smoking shall be permitted during refueling.

M.17 Fire Protection

- M.17.7 Internal combustion engines shall be stopped and ignition shall be in the "off" position during refueling, except on diesel equipment having the fuel tank remotely located with respect to the engine.

OHIO

Contact:

Ohio Division of Mines
2323 West 5th Ave.
Box 825
Columbus, Ohio 43216
614/446-4240

Coal, Metal, and Nonmetal Mines

Mining Laws of Ohio, 1977, Department of Industrial Relations, Division of Mines.

Chapter 4157

Mine Equipment: Safety Regulations

Section 4157.35: Use of gasoline, naphtha, and oil in mines. No gasoline, naphtha, kerosene, fuel oil, or gas engines shall be used in a mine, except for operating pumping machinery where electric, compressed air or steampower is not available or cannot be transmitted to the pump, in which case the owner, lessee, or agent shall observe the following:

- (c) The supply tank from which the gasoline, naphtha, kerosene, or fuel oil is fed to the engine, shall be of metal, with a suitable screw cap opening, fitted with a gasket, so as to make the tank airtight and prevent escape of gas into the atmosphere, and the tank kept free from leaks.
- (d) The gasoline, naphtha, kerosene, or fuel oil shall be fed from a tank to the carburetor or mixer by metal tubes securely connected so as to reduce the possibility of leaks to a minimum.
- (e) The exhaust from the engine shall be conducted by means of metal pipes into the return air current, so that the combustion fumes will not enter the workings of the mine where the men are required to work, or be conducted in an upcast shaft or slope not used as a means of ingress or egress or through metal pipes to the surface.
- (f) At no time shall more than 5 gallons of such gasoline, naphtha, kerosene, or fuel oil be taken into the mine, including that in the supply tank.
- (g) No gasoline, naphtha, kerosene, or fuel oil shall be taken into the mine except in metallic cans, with screw cap opening at the top, fitted with a suitable gasket.
- (h) No package, can, or supply tank of an engine, containing gasoline, naphtha, kerosene, or fuel oil, shall be opened until ready to make the transfer from the package or can to the supply tank, and in transferring, a funnel shall be used so as to avoid spilling the gasoline, naphtha, kerosene or fuel oil, and the cap on the supply tank shall be immediately closed.

- (i) In no case shall the package, can, or supply tank be opened when an open light or other things containing fire is within 25 ft of the same, provided that subject to the approval of the chief, the restrictions in the use of fuel oil in a mine shall not apply to mobile or portable machinery, if such mobile or portable machinery is used in a clay, limestone, shale, or any other mine not a coal mine.

No owner, lessee, agent, or operator of a mine shall violate this section. Penalty, 4157.99.

OKLAHOMA

Contact:

State of Oklahoma
Department of Mines
4040 Lincoln, Suite 107
Oklahoma City, Okla. 73105
405/521-3859

Coal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground coal mines.

Metal and Nonmetal Mines

Mining Laws of the State of Oklahoma, 1973.

Par. 441: Use of engines equipped for detoxification permitted--Approval of use--Inspections--Suspension or discontinuance of use.

The use of diesel engines equipped for detoxification in accordance with rules and regulations promulgated by the U.S. Bureau of Mines may be used (sic) in lead, zinc, and other metal mines in this state, provided, the use of such engine or engines in any such mine is first found to be safe for the miners who work in said mine, by the Assistant Mine Inspector, and such finding is approved by the Chief Mine Inspector and provided, further, that the diesel engine or engines and the safety equipment thereon to be used in any such mine shall also have been approved for use in such mine, by the Assistant Mine Inspector, and such finding is approved by the Chief Mine Inspector. The Assistant Mine Inspector and the Chief Mine Inspector, in issuing any such approval, shall follow the rules, regulations, and recommendations of the U.S. Bureau of Mines. The Assistant Mine Inspector shall make periodic inspections to determine whether such engines in such mines are emitting fumes which make it unsafe for such engines to be used. The Assistant Mine Inspector or the Chief Mine Inspector shall have the authority to order that conditions be remedied and to suspend the use of such engines in any mine, or to order the discontinuance altogether of such engines in any such mine. Such orders shall be enforced as other orders of such officers are enforced.

Par. 442: Use of engines not meeting standards prohibited.

It shall be unlawful to use or to order or permit the use of diesel engines in any lead, zinc or other metal mine in this state at any time which is not equipped with detoxification equipment and other safety devices meeting the standards set forth.

OREGON

Contact: Workmen's Compensation Board
Accident Prevention Division
Labor and Industrial Boulevard
Salem, Oreg. 97310
530/378-3272

Coal, Metal, and Nonmetal Mines and Tunneling

Oregon Safety Code for Places of Employment, Chapter 24, Safety Code for Mining, Tunneling and Quarrying, 1962.

Section V: Ventilation Requirements

24-5-19: Workmen shall not be required to work in any atmosphere which contains hazardous gas or vapor in excess of the maximum allowable concentrations as shown in the following table:

<u>Name of Gas or Vapor</u>	<u>Parts per Million</u>
Ammonia.....	100
Benzene.....	25
Carbon Dioxide.....	5,000
Carbon Monoxide.....	100
Chlorine.....	1
Gasoline.....	500
Hydrogen Cyanide.....	10
Hydrogen Sulphide.....	20
Naphtha (Petroleum).....	500
Nitrogen Oxides (Total).....	25
Nitrogen Dioxide.....	5
Radon and "Daughters".....	300 micro-microcuries per liter of air

Diesel Equipment

24-5-26: The use of diesel equipment underground will be permitted, providing the following regulations are met:

- (a) The diesel engine shall be equipped with an exhaust conditioner which will treat the exhaust gas so that when it issues into the mine atmosphere, the temperature of the exhaust gas will not exceed 180° F at any time during a four-hour shift.

- (b) The conditioner shall be large enough to hold sufficient water at all times. Water in the conditioner is to be completely drained and replenished once every shift, and the conditioner must be checked, serviced and cleaned once each week, or more often if necessary.
- (c) There shall be sufficient fresh air supplied so that there will be a minimum of 100 cu ft/min of free air for each brake horsepower in addition to the 100 cu ft/min of air required per person.
- (d) Working areas in which diesels are used shall be examined frequently and air samples taken to determine the mine atmosphere.
- (e) Operation of diesel equipment shall immediately cease when concentrations of any one of these gases are found to exceed the following amounts:
 - 1. Carbon monoxide--0.01 vol-pct (100 ppm)
 - 2. Carbon dioxide--0.5 vol-pct (5,000 ppm)
 - 3. Oxides of nitrogen (total)--0.0025 vol-pct (25 ppm)
 - 4. Aldehydes--0.001 vol-pct (10 ppm)
 - 5. Nitrogen dioxide--0.005 vol-pct (5ppm)
- (f) Diesel equipment shall not be operated during any time when ventilating fans are shut down.
- (g) At least once each week an inspection of the diesel engine exhaust conditioner must be made and any necessary repairs made.
- (h) Diesel engines shall not be operated when flammable gas (methane) is found to exceed 1.25 vol-pct of air.
- (i) Oil used as fuel for diesels underground shall have a flash point of not less than 140° F, and the sulphur content shall not be greater than 0.5 of 1.0 wt-pct. Fuels with a heavy asphalt base shall not be used.
- (j) Only sufficient fuel oil for one shift shall be taken underground. Suitable strong, sealed metal containers shall be used for this purpose, and the empty containers removed immediately from underground locations.
- (k) The diesel engine fuel tank shall be filled by means of direct transfer only. Where possible, any oil spilled shall be taken up at once and deposited in a fireproof receptacle which shall be removed to an above ground location daily.

Editorial Note: Regulations are still in force, but there is presently no enforcement by State agency.

PENNSYLVANIA

Contact: Department of Environmental Resources
Box 2063
914 Executive House
Second and Chestnut
Harrisburg, Pa. 17120
717/787-1376

Coal Mines

Bituminous Coal Mining Laws of Pennsylvania for Underground Mines, 1961.

Article II:

L. TransportationSection 269: Underground Equipment; Use and Maintenance

- (b) Underground equipment powered by internal combustion engines using petroleum products, alcohol, or any other compound shall not be used in a coal mine unless such equipment has been approved by the secretary for underground use in bituminous coal mines.
- (c) Locomotives, mine cars, supply cars, shuttle cars, and all other haulage equipment shall be maintained in a safe operating condition.

Article VI:

Auger MiningSection 603: Special Requirements

- (l) Internal combustion engines in the vicinity of auger holes shall be stopped while auger holes are being inspected.
- (s) Exhaust gases from internal combustion engines shall be conducted away from auger holes and the working area for the protection of the workmen and to prevent ignitions of gas or dust emanating from such holes.
- (t) Exhausts shall be equipped with mufflers to reduce noise, guarded where necessary to prevent burns, and extended at least to the height of the machinery.

Article VII:

MiscellaneousSection 705: Specific Repeals

(a) The following Acts and all amendments thereof are repealed absolutely:

8. The act of December 28, 1951 (P.L. 1801), entitled "An Act Regulating the Use of Machinery Powered by Internal Combustion Engines or Motors in Coal Mines"

Editorial Note: Phone contact has revealed that no permits are issued to operators to allow diesel-powered equipment in coal seams underground, but their use in rock tunnels as part of coal mines may be permitted.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines. Pennsylvania has adopted Federal underground mining regulations for metal and nonmetal mines.

RHODE ISLAND

Contact: Rhode Island Department of Labor
235 Promenade St.
Providence, R.I. 02908
401/277-2734

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Rhode Island presently has no underground mines.

SOUTH CAROLINA

Contact: South Carolina Department of Labor
Division of Occupational Health and Safety
Landmark Center
Box 11329
Columbia, S.C. 29204
803/758-3080

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. South Carolina presently has no underground mines.

SOUTH DAKOTA

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. South Dakota has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

Editorial Note: There is no State agency regulating mining.

TENNESSEE

Contact:

Department of Labor
Division of Mines
Box 124
Caryville, Tenn. 37714
615/562-4914

Coal Mines

Mines and Mining, Laws and Regulations (Title 58), Tennessee Department of Labor.

Chapter 7: Commercial Coal Mines--Ventilation

58-705: Quality of Air

- (a) Air in which men work or travel in mines shall be improved when it contains less than 19.5 pct oxygen, more than 0.5 pct carbon dioxide, or is contaminated with noxious or poisonous gases.

Chapter 8: Commercial Coal Mines--Transportation in Mines

58-806: Internal Combustion Engines Prohibited

Internal combustion engines or other machinery which gives off noxious fumes shall not be permitted underground in any coal mine.

Chapter 11: Mines Other Than Commercial Coal Mines--General Regulations

58-1114: Diesel Equipment Underground

Diesel equipment equipped for detoxification may be used in mines in this state; provided the use of such engine or engines in any such mine is first found to be safe for the miners who work in said mine, by the Chief Mine Inspector, and provided further, that the diesel engine or engines and the safety equipment thereon to be used in any such mine shall also have been approved for use in such mine by the Chief Mine Inspector.

1978, A Cumulative Supplement--Laws and Regulations Governing Mines and Mining in Tennessee (Title 58), Tennessee Department of Labor, Division of Mines.

58-705: Quality of Air

- (a) All active underground working places shall be ventilated by a current of air containing not less than 19.5 pct of oxygen, not more than 0.5 pct of carbon dioxide, and no harmful quantities of other noxious or poisonous gases.

58-806: Internal Combustion Engines Prohibited

Haulage equipment kept in safe operating condition--
Internal combustion engines or other machinery which gives off noxious fumes shall not be permitted underground in any coal mine. Locomotives, mine cars, shuttle cars, supply cars, conveyors, and all other haulage equipment shall be maintained in a safe operating condition. Acts 1951, Ch. 245, Par. 47 (Williams, Par. 5615): 1957, Ch. 253, Par 21.

58-1507: Stop Operations--Maintenance of Pits

(n) Auger Mining

- 6. The exhaust pipe from the motor which operates the hydraulic system shall be extended to prevent exhaust fumes from contacting the operator. The exhaust pipe shall be guarded so as to protect persons from being burned by contact.

Metal and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground metal and nonmetal mines. Tennessee has adopted Federal underground mining regulations for metal and nonmetal mines.

TEXAS

Contact:

State of Texas
Land Resources
1700 North Congress
Austin, Tex. 78701
512/475-6491

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Texas has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

UTAH

Contact:

Utah State Coal Mine Inspector
Diesel Permits
79 West 4th South
Price, Utah 84501
801/637-3051

Coal Mines

General Safety Orders Cover Coal Mining Operations in the State of Utah, effective January 1, 1976.

Section 40: Coursing of Air

- (a) All active underground working places in a mine shall be ventilated by a current of air containing not less than 19.5 pct of oxygen, not more than 0.5 pct of carbon dioxide, and no harmful quantities of other noxious or poisonous gases.
- (b) Diesel-powered equipment may be used underground in well-ventilated areas, provided a permit to use such equipment is obtained from the Industrial Commission of Utah.

Application forms are provided by the Commission. A permit is required for each unit.

- (c) Wherever diesel engines are used underground, there shall be a minimum of 150 cu ft/min of air flow for each brake horsepower of diesel engine in operation. Ventilation and operating conditions shall be such that atmospheric contaminants do not exceed the following tolerable limits:

Carbon dioxide--not more than 0.5 vol-pct
Carbon monoxide--not more than 0.01 vol-pct
Oxides of nitrogen--not more than 0.0025 vol-pct

- (d) Diesel engine exhaust gases shall pass through a water conditioner before discharging into the mine atmosphere. The water must be drained from the scrubber and replenished once each working shift.

Metal and Nonmetal MinesContact:

The Industrial Commission of Utah
350 E. 500 South
Salt Lake City, Utah 84111
801/533-5711

Metal and Nonmetal Mines

State of Utah Metal and Nonmetal Mine Health and Safety Standards.

Section 19: Ventilation

B. Diesel-Powered Equipment Used Underground

1. Diesel-powered equipment may be used underground in well-ventilated areas, providing a permit to use each equipment is obtained from the Industrial Commission of Utah. Application forms are provided by the Commission. A permit is required for each unit.
2. Wherever diesel engines are used underground, there shall be a minimum of 150 cu ft/min of air flow for each brake horsepower of diesel engine in operation. Ventilation and operating conditions shall be such that atmospheric contaminants do not exceed the threshold limit values as established by the latest edition of the American Conference of Industrial Hygienists.
3. Where a fire hazard exists, engine exhaust gas shall be effectively cooled with a scrubber, flame arrester, or other means.

VERMONT

Contact: Department of Labor and Industry
State Office Building
Montpelier, Vt. 05603
802/828-2286

Coal, Metal, and Nonmetal Mines

There are no known State regulations pertaining to the use of internal combustion engines in underground mines. Vermont has adopted Federal underground mining regulations for coal, metal, and nonmetal mines.

VIRGINIA

Contact: Division of Mines and Quarries
Virginia Department of Labor and Industries
219 Wood Ave.
Big Stone Gap, Va. 24219
703/523-0335

Coal Mines

Conditions of Permit Pursuant to Section 45.1-90(b) Code of Virginia, as amended.

Underground Coal Mine Usage of Diesel Equipment

Necessity and Function: This regulation is to permit the use of diesel-powered equipment in underground mines for the purpose of reducing the number of electrocutions and mine fires from electrical cables.

Section 1. General Requirements for the Use of Diesel Equipment

- (1) Only diesel equipment bearing approval plates of permissibility issued by the Federal Mining Enforcement and Safety Administration and approved for use by the Virginia Division of Mines and Quarries will be allowed in underground coal mines of the State. No diesel-powered machinery may be taken into any underground coal mine of the State of Virginia without the written approval of the Chief of the Division of Mines and Quarries. The approval for use shall incorporate all the requirements of these regulations. If at any time the Chief determines that any condition or practice permitted under this approval may threaten the health or safety of the employees, he may impose additional requirements for the purpose of eliminating the condition or practice.
- (2) If technical, scientific or engineering information is gained indicating that approved diesel machinery may be used in a manner which will afford workmen equal or greater protection than afforded by the provisions of these regulations, the Chief may approve the use of the machinery in the manner which provides equal or greater protection.
- (3) Mining Enforcement and Safety Administration approval of the permissibility of mobile diesel-powered transportation equipment (herein-after referred to as diesel machine(s)) means only that the particular machine has met certain specific requirements of design and performance, but such approval does not guarantee that it is impossible to use a permissible machine in an unsafe manner. The manufacturer must develop equipment that will meet the particular requirements for approval, but it is the user's responsibility to see that the equipment is maintained in permissible condition and is used in a permissible manner. In addition to proper maintenance, the use of diesel machines underground involves certain other factors, such as ventilation, which are of equal importance in establishing safe operating conditions. It is absolutely essential to observe the requirements of these regulations in operating and maintaining such machines to avoid impairing their permissible status and thus defeat the protective features that are necessary for their safe use.
- (4) Engine adjustments shall be verified by the manufacturer as being correct before each permissible diesel machine is operated in a coal mine.
- (5) Alteration in design, substitution of components or subassemblies, or changes in conditions of operating permissible diesel machines shall not be made without prior concurrence of the Virginia Division of Mines and Quarries and the Mining Enforcement and Safety Administration. When such changes are permitted, additional engine tests and adjustments shall be required as necessary to ensure the safe operation of the particular machine in a coal mine.

Section 2. Proper Ventilation to be Maintained for the Mines in Which Diesel-Powered Equipment is Used.

- (1) The use of diesel machines underground shall be restricted to haulageways and working places where positive (controlled flow) ventilation is maintained.
- (2) The ventilating air in all mine workings where diesel machines are operated shall not contain combustible or other contaminating gases in such concentration that will affect combustion in the diesel engine by materially increasing production of toxic (poisonous) or other objectionable constituents in the engine exhaust.
- (3) Each set of producing entries in which diesel-powered equipment is used shall be placed on a separate split of air.

Section 3. In Mines Using Diesel-Powered Equipment the Quantity of Ventilating Air Must Meet the Following Standards:

- (1) In addition to the amount of air required by the Virginia Mining Law, at least 17,000 cu ft/min of air shall be provided for each diesel unit used in a working section of a mine. The air measurement shall be taken in the last open entry crosscut. If these locations cannot be used due to pillaring, the measurements shall be taken at the intake and return of the section. The quantity of ventilating air shall be adequate to dilute the toxic and/or objectionable constituents of the engine exhaust so that the composition of the air in each haulageway and working place connected thereto will meet authoritative standards for safe, healthful working environment.
- (2) The minimum quantity of ventilating air that must be supplied for a permissible diesel machine in a given time shall conform to that shown on the approval plate attached to the particular machine.
- (3) The quantity of ventilating air in mine workings where diesel machines are operated shall be measured once during each working shift and a record of each measurement shall be kept in a book provided for this purpose.
- (4) No person shall incorporate any device in the exhaust system of a permissible diesel machine that has not been approved in the tests that determine the permissibility of the machine.

Section 4. Maintaining Proper Quality Air in Mines That Use Diesel-Powered Equipment.

- (1) The air supplied for ventilation where diesel machines are used in coal mines shall contain not less than 20.5 vol-pct of oxygen (dry basis) and not more than 1.0 vol-pct of methane.

- (2) The ventilating air in working places where diesel machines are operated shall be sampled and analyzed chemically often enough to assure that the composition of the engine intake air conforms with requirements stated in subsection (1) of this section and that the concentrations of contaminants, such as carbon dioxide, carbon monoxide, and oxides of nitrogen, when added to the ventilating air by the diesel-engine exhaust, shall meet authoritative standards for safe, healthful working environment.
- (3) Ventilation and machine-operating conditions shall maintain the composition of the air in the pertinent mine workings so that the tolerable limits stated in subsections (1) and (2) of this section will not be exceeded.
- (4) Diesel-engine exhaust shall not contain black smoke.
- (5) When the conditions of the quality of air stated in subsections (1), (2), and (3) of this section are not maintained, as determined by analysis or other observation, operation of diesel machines shall be stopped until the requirements of air quality are complied with.
- (6) Records shall be kept of all air analyses and of any change(s) in ventilation or diesel engine adjustment resulting from the analyses.

Section 5. Maintenance of Diesel Machines to be Maintained According to the Following Rules:

- (1) The maintenance of diesel machines in permissible condition shall be delegated only to authorized, competent persons.
- (2) Engine intake and exhaust systems shall be inspected visually at least once each working shift. Other diesel machine components shall be inspected in accordance with instruction of the manufacturer. Records shall be kept of the inspections.
- (3) Maintenance, inspection and repair work shall be done in accordance with instructions of the manufacturer. Records shall be kept of maintenance, inspection and repair work.

Section 6. The Maintenance of the Engine-Fuel-Injection System.

- (1) Injection valves:
 - (a) Injection valves shall be maintained in proper operating condition. Particular attention shall be given to preventing imperfect atomization or distribution of the fuel.
 - (b) Replacement of worn or broken injection valves shall be identical with those on the engine when the diesel machine was approved as permissible.

(2) Fuel pump:

- (a) The engine fuel pump shall be sealed or locked to prevent tampering. The seal shall be broken only by an authorized competent person, when necessary to reset the fuel pump, after which the pump shall be resealed.
- (b) Resetting of the stop limiting maximum fuel injection of the fuel pump shall be identical with the original setting provided by the manufacturer.
- (c) Each shop or facility in which diesel engines are serviced shall be provided with equipment for properly measuring the quantity of fuel delivered by the fuel pump when operating at maximum fuel setting, or such adjustments shall be made only by a competent diesel service organization where such equipment is available.
- (d) The fuel pump shall be set to deliver the maximum weight of fuel specified in the certifications provided by the Mining Enforcement and Safety Administration and the Virginia Division of Mines and Quarries.
- (e) When operating a diesel engine at altitudes exceeding 1,000 ft above sea level, the maximum quantity of fuel injected by the fuel pump shall be set in accordance with the liquid fuel rate/altitude table provided in the manufacturer's caution statement.

Section 7. The Procedures to Follow in Inspection and Maintenance of Engine-Intake System.

- (1) The engine-intake system including flame arrester(s), air cleaner, and all joints shall be inspected at intervals according to the manufacturer's general maintenance instructions.
- (2) Inspection of the engine-intake system shall include tightness of all joints and cleanliness of flame arrester surfaces.
- (3) Periodic measurements shall be made of the vacuum in the engine-intake system to determine whether the air cleaner and flame arrester(s) require cleaning.
- (4) The air cleaner of the engine-intake system shall be maintained in accordance with the manufacturer's instructions. The normal oil-filling level shall not be exceeded.

Section 8. When and How to Inspect and Maintain the Engine-Exhaust System.

- (1) The engine-exhaust system, including flame arrester(s), conditioner or cooling boxes, shut-off mechanism, water spray, and

exhaust-dilution system, shall be inspected at intervals according to the manufacturer's general maintenance instructions.

- (2) Periodic measurements shall be made of the positive pressure in the engine-exhaust system to determine whether the exhaust flame arrester requires cleaning.
- (3) The water supply for the exhaust-gas cooling system shall be replenished by an authorized person at the beginning of each working shift.
- (4) When salts from evaporation of water in the exhaust-gas cooling system are deposited on auxiliaries, such as cooling boxes, conditioners and other parts of the system, such auxiliaries shall be flushed with water and cleaned to remove the salt deposits, as well as soot filtered from the exhaust gas.
- (5) Float valves shall be serviced at intervals according to the manufacturer's instructions to maintain them in good operating condition.
- (6) Functioning of the fuel shut-off mechanism actuated by the exhaust-gas temperature, shall be tested at least once every three months. This test shall be made in a safe place, not in active face workings of a coal mine.
- (7) All heated surfaces of the diesel engine shall be inspected and cleaned at least weekly or at intervals frequent enough to ensure that such surfaces are kept free of combustible materials, such as coal dust, diesel fuel, lubricants, and rags or waste, or as often as may be required by the Mine Inspector.

A minimum of 12 inches of clearance shall be maintained between all heated surfaces of the diesel equipment and the roof or ribs of the mine opening.

- (8) The exhaust-gas dilution system shall be inspected and cleaned at intervals frequent enough to ensure safe dilution of the exhaust gas when it is discharged from the diesel engine.
- (9) Whenever the diesel-engine exhaust is smoky or objectionable odors are emitted in the exhaust, the cause shall be investigated immediately and corrected in accordance with the manufacturer's instruction.

Section 9. The Use and Maintenance of Electrical Components of Diesel Equipment.

- (1) Locks and seals.
Electrical parts, such as battery boxes and headlights, shall be provided with locks and seals that are maintained where required to preserve the permissible status of a permissible diesel machine.

(2) Fastenings.

Joints in motor casings, starting-switch enclosures, headlights, and other parts that are subject to arcing during normal operation shall be fastened securely. All bolts, cap screws, and other means of joining parts of casings and enclosures shall be kept in their proper places and secured tightly.

(3) Wiring and conduit.

(a) Wiring insulation shall be maintained in good condition and when worn or abraded shall be replaced with well-insulated wiring.

(b) Rubber hose, steel pipe, and other types of conduit for wiring shall be supported firmly at each end and between ends when the lengths are such as to require additional support. Conduit and other means of protecting wiring shall be kept in place and maintained in condition equivalent to that provided by the manufacturer for the permissibility tests.

(4) Headlight and instrument lenses.

Lenses forming part of the explosion-proof casings of headlights or enclosures of instruments shall be held securely in place. Cracked lenses shall be replaced immediately.

(5) Overload and short-circuit protection.

Tampering with fuses, relays or other means supplied by the manufacturer for overload and short-circuit protection of wiring and electrical parts shall not be permitted, nor shall the use of substitutes that nullify such protection be permitted.

(6) Battery.

Battery-cell tops shall be maintained free of electrolyte and other foreign material. Connections between battery cells shall be kept tight and free of corrosion.

Section 10. Fuel Usage in Diesel-Powered Equipment.

(1) Specifications.

(a) The fuel for diesel engines of machines approved for service in underground mines shall conform to the equipment manufacturer's specifications for viscosity, pour point, cetane number, carbon residue and water. The flash point shall be not less than 140° F, and the sulphur content shall not exceed 0.5 wt-pct.

(b) Only distillate fuel shall be used in engines of permissible diesel-powered transportation equipment for underground mines.

(2) Storage and handling.

- (a) Fuel taken underground shall be transported only in strong, tight metal containers that are provided with efficient closing devices.
- (b) The quantity of fuel stored underground shall not exceed that required for 24 hours operation of all diesel machines in use.
- (c) Fuel taken underground and awaiting transfer to diesel machine fuel tanks shall be stored in a closed compartment, constructed of incombustible materials, and shall be kept in a well-ventilated location, the return air from which shall not pass through any active mine workings.
- (d) The walls of a fuel-storage compartment shall form a liquid-tight joint with the bottom of mine floor. Any opening in the fuel-storage compartment, such as a doorway, shall be provided with a sill high enough to form a catch-basin in the storage compartment to retain spilled fuel. The capacity of the catch-basin shall be large enough to hold the maximum quantity of fuel that is permitted to be stored underground.
- (e) Diesel machine fuel tanks shall be filled only at the fuel-storage compartment. Fuel shall be transferred from the storage compartment to a machine fuel tank through a flexible hose that is fitted with a self-closing valve.
- (f) The fuel-handling system and the diesel machine shall be frame-grounded when fuel is being transferred from the storage compartment to the machine fuel tank.
- (g) The air vents on fuel-handling equipment shall be flame-proof.
- (h) When fuel is being transferred from the storage compartment to the machine fuel tank, the diesel engine shall be stopped.
- (i) A supply of sand or other suitable incombustible material shall be available during the transfer of fuel from the storage compartment to the machine fuel tank for absorbing spilled fuel.
- (j) All drain plugs in the fuel-handling system shall be threaded and sealed or locked in the closed position to prevent unintentional opening.
- (k) Only trained authorized persons shall be permitted to handle fuel for diesel machines.
- (l) In fuel-handling operations, precautions shall be observed to keep the fuel clean and free from contamination by foreign material, such as dirt, sediment and water.

- (m) Fuel filters on diesel engines shall be cleaned regularly and repaired promptly as conditions require.

Section 11. Types of Fire Extinguishers Used and Their Storage.

- (1) Liquid carbon dioxide or pressurized dry-chemical fire extinguishers shall be installed at underground repair shops, machine barns, and fuel storage compartments.

Section 12. Maintenance of Underground Repair Shops and Machine-Storage Barns.

(1) Ventilation.

- (a) Underground repair shops and diesel machine storage barns shall be ventilated by a separate air split between the intake and return airways.
- (b) When diesel machines are operated in underground repair shops or storage barns, or in the event of fire, arrangements shall be made to conduct the products of combustion therefrom directly to the return airway.

(2) Construction.

- (a) Underground repair shops and machine-storage barns shall be lined with nonabsorbent, incombustible material. Doors or other means of closure shall be constructed of similar incombustible material.
- (b) Floors of underground repair shops and machine-storage barns shall be impervious to oil and shall be so graded as to provide natural drainage to a sump or catch-basin to collect spilled oil.
- (c) Spilled oil shall be cleaned up and removed from the sump or catch-basin promptly and stored in closed metal containers until disposed of on the surface.

(3) Repair Operations.

Welding or other operations that might create a fire hazard shall not be done unless precautions are observed to prevent inadvertent ignition of diesel fuel or lubricants.

(4) Miscellaneous.

A supply of sand or other incombustible material shall be kept in underground repair shops and machine-storage barns to aid in fire fighting and to absorb spilled fuel or lubricants.

Section 13. General Conditions Governing the Operation of Diesel-Powered Equipment in Underground Mines.

- (1) The operation of diesel equipment in underground coal mines in Virginia shall be under the supervision of a foreman holding a Virginia Mine Foreman Certificate.
- (2) Not more than two diesels will be permitted to operate at the same time in a single air split; provided, however, that the Chief Mine Inspector may, if he determines that the safety or health of the employees will not be jeopardized, permit additional equipment to be used.
- (3) No diesel equipment will be permitted to operate in any section of a mine where room entries exceed 3,000 ft in depth.
- (4) The engine shall be shut down at all times when not in use.
- (5) If the engine exhaust becomes more noticeable than normal, the equipment shall be removed from the faces and shut down until the proper repairs can be made to correct this condition.
- (6) All employees working in sections where diesel equipment is used shall be furnished with self-rescue respirators which they shall carry at all times while on duty in the mine.
- (7) No person who works in close proximity to mobile diesel equipment throughout the shift shall be permitted to work more than a ten-hour continuous shift in any 24 hours.
- (8) Access to all company records such as maintenance, repairs, fuels, ventilation, etc., pertaining to the use of the underground diesel equipment shall be made available to representatives of the Virginia Division of Mines and Quarries upon request. The mine operator shall keep and make available other pertinent records as prescribed by the Virginia Division of Mines and Quarries.
- (9) The operation of any diesel machine in any manner or under any condition that does not comply with the requirements of these regulations shall be considered by the Division as voiding its approval for underground use.

Metal and Nonmetal Mines

Rules and Regulations Governing the Mining of Metal and Nonmetallic Minerals, April 15, 1974, Department of Labor and Industry, Division of Mines and Quarries, Commonwealth of Virginia, Richmond, Virginia.

4557.4 Fire Prevention and Control

- 4557.4-21: Internal combustion engines, except diesels, shall be shut-off and stopped before being fueled.

4557.4-52: No gasoline, benzene, kerosene, or other flammable oils shall be used underground in powering machinery, except that equipment powered by diesel engines, approved by the Chief before installation, may be used underground in the operation of other than coal mines.

4557.4-54: Oil, grease, or diesel fuel stored underground shall be kept in suitable tightly sealed containers in fire-resistant areas at safe distances from explosives magazines, electrical installations, and shaft stations.

4557.4-56: Oil or fuel storage areas shall not be located in main ventilation airways.

4557.19 Man Hoisting
Hoists

4557.19-13: Where any diesel or similar fuel-injection engine is used to power a hoist, the engine shall be equipped with a damper or other cutoff in its air intake system. The control handle shall be clearly labeled to indicate that its intended function is for emergency stopping only.

4557.21 Gassy Mines
Equipment

4557.21-76: Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face and rib.

4557.21-78: Only permissible equipment maintained in permissible condition shall be used beyond the last open crosscut or in places where dangerous quantities of flammable gases are present or may enter the air current.

Mining laws (Including Oil and Gas) of Virginia, Code of Virginia of 1950 and the 1978 Cumulative Supplement, Department of Labor and Industry, the Michie Company, Charlottesville, Virginia.

Chapter 9: Fire Prevention, Fire Control and Mine Disasters

45.1.90: Flammable oils; internal combustion engines.

(a) No gasoline, benzene, kerosene or other flammable oils shall be used underground in powering machinery without the written approval of the Chief.

(b) Internal combustion engines shall not be permitted underground in any coal mine except with the written approval of the Chief (Code 1950 repl. Vol. 1958, Par. 45-43; 1954, c. 191; 1966, c. 594; 1978, c. 729.)

The 1978 Amendment substituted, at the end of subsection (a), "without the written approval of the Chief" for "except that equipment powered by diesel engines, approved by the Chief before installation, may be used underground in the operation of other than coal mines, and except as hereinafter provided." The amendment also deleted the former second sentence of subsection (b), which read: "The Chief may in his discretion approve diesel-powered locomotives, shuttle cars, or other equipment, which may be operated only upon his written permission and under such rules as he may promulgate."

WASHINGTON

Contact: Department of Labor and Industries
Division of Industrial Safety and Health
308 4th Ave.
Olympia, Wash. 98504
206/753-9643

Coal Mines

Washington Safety Standards, WAC 296-61-320.

WAC 296-61-320: Gassy Mines

(10) Equipment

- (a) (57.21.76) Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face and rib.
- (c) (57.21-78) Only permissible equipment maintained in permissible condition shall be used beyond the last open crosscut or in places where dangerous quantities of flammable gases are present or may enter the air current.

Metal and Nonmetal Mines

Washington Safety Standards, Metal and Nonmetallic Mines, Quarries, Pits and Crushing Operations, Chapter 296-61 WAC, April 1, 1972.

WAC 296-110: Regulations Pertaining to Use of Diesel Equipment Underground.

Permission will be granted for specified diesel equipment working in a specified location under specified conditions, as follows:

- (1) Application shall be made to the Mining Section, Division of Safety, Department of Labor and Industries, for permission to use specified diesel equipment in a specified underground area and should include the following information.
 - (a) The type of construction and complete identification data and specifications including analysis of the undiluted exhaust gases of the diesel equipment.

- (b) The location of the underground mine where the diesel equipment is to be used, accompanied by a drawing showing the underground area and description of the ventilation system.
- (2) Before the diesel equipment is taken underground, written permission shall be obtained from the Division of Safety or its duly authorized representative. A satisfactory test of the surface to show that the exhaust gases do not exceed the maximum pct of carbon monoxide permitted, shall be required.
- (3) Diesel equipment may only be used underground where the mine ventilation is controlled by mechanical means and shall not be operated if the ventilating current is less than 75 cu ft/min per horsepower, based on the maximum brake horsepower of the engines.
- (4) Air measurements shall be made at least once weekly in the diesel engine working area and the measurements entered in the Underground Diesel Engine Record Book. Permissible maximum amounts of noxious gases are as follows:

At engine exhaust ports	Carbon monoxide	0.1 pct	1,000 ppm ^a
Next to equipment	Carbon monoxide	.005 pct	50 ppm
General atmosphere	Carbon monoxide	.005 pct	50 ppm
General atmosphere	Nitrogen Dioxide	.0005 pct	5 ppm
General atmosphere	Aldehydes	.0002 pct	2 ppm

^a--Parts of vapor or gas per million parts of contaminated air by volume at 25° C and 760 mm Hg pressure.

WEST VIRGINIA

Contact: West Virginia Department of Mines
Room E 151, State Capitol Building
Charleston, W. Va. 25305
304/348-2051

Coal Mines

Mining Laws of West Virginia, Chapter 22, Revised July 1977.

Article 2: Coal Mines--Ventilation

Par. 22-2-4: Ventilation of Mines in General

All active underground working places in a mine shall be ventilated by a current of air containing not less than 19.5 pct oxygen, not more than 0.5 pct carbon dioxide, and no harmful quantities of other noxious or poisonous gases.

Article 2: Coal Mines--Mine Foreman

Par. 22-2-14: Safety Inspections; Removal of Gases

It shall be the duty of the mine foreman, assistant mine fireman or fire boss to examine all working places under his supervision for hazards at least once every two hours during each coal-producing shift, or more often if necessary for safety. In all mines such examinations shall include tests with an approved detector for methane and oxygen deficiency and may also include tests with a permissible flame safety lamp. It shall also be his duty to remove as soon as possible after its discovery any accumulations of explosive or noxious gases in active workings, and where practicable, any accumulations of explosive or noxious gases in the worked out and abandoned portions of the mine.

Article 2: Coal Mines--Transportation

Par. 22-2-37: Haulage Roads and Equipment; Shelter Holes; Prohibited Practices; Signals; Inspections

(m) No steam locomotive shall be used in mines where men are actually employed in the extraction of coal, but this shall not prevent operation of a steam locomotive through any tunnel haulway or part of a mine that is not in actual operation and producing coal.

(n) Underground equipment powered by internal combustion engines using petroleum products, alcohol or any other compound shall not be used in a coal mine.

Metal and Nonmetal Mines

Article 3: Open-Pit Mines, Cement Manufacturing Plants and Underground Limestone and Sandstone Mines

Part 2: Applicability of Mining Laws

All provisions of the mining laws of this state intended for the health and safety of persons employed within or at any coal mine and for the protection of any coal mining property shall extend to all open-pit mines and any property used in connection therewith for the mining of underground limestone and sandstone mines, insofar as such laws are applicable thereto.

WISCONSIN

Contact:

Mine Safety Section
 Department of Industry, Labor and Human Resources
 Box 7969
 Madison, Wis. 53702
 608/266-7529

Coal, Metal, and Nonmetal Mines

Mines, Pits and Quarries, Rules of Industry, Labor and Human Relations,
 Wisconsin Administrative Code Chapter Ind. 3.

Ind. 304 Fire Prevention and Control

General--Surface and Underground

- (21) Internal combustion engines, except diesels, shall be shut-off and stopped before fueling.

Ind. 305 Air Quality, Ventilation and Radiation

Underground Only

- (15) Atmospheres in all active areas shall contain at least 20 pct oxygen.
- (16) Atmospheres in all active areas shall contain:
- (a) Not more than 0.005 pct carbon monoxide, 0.5 pct carbon dioxide, and 5 ppm nitrogen dioxide, or other threshold limit values for these gases adopted by the American Conference of Governmental Industrial Hygienists. (See Wis. Adm. Code, Chapter Ind. 20--Dust, Fumes, Vapors and Gases.)
 - (b) No harmful quantities of other gases, fumes or mists as determined by threshold limit values established by the American Conference of Governmental Industrial Hygienists. (See Wis. Adm. Code, Chapter Ind. 20--Dust, Fumes, Vapors and Gases.)

Ind. 306 Ventilation and Radiation

Ventilation--Underground Only

- (12) Internal combustion engines other than department approved diesels shall not be used underground and such approved diesels shall be operated in an approved manner and maintained in approved condition.

Ind. 321 Gassy Mines

Equipment

- (75) Diesel-powered equipment not approved as permissible by the department for use in mines subject to these regulations shall not be used underground. Permissible equipment shall be maintained in permissible condition.
- (76) Diesel-powered equipment shall not be taken into or operated in places where flammable gas exceeds 1.0 pct at any point not less than 12 inches from the back, face and rib.

WYOMING

Contact:

State Inspector of Mines
 State of Wyoming
 Box 1064
 Rock Springs, Wyo. 82901
 307/362-5222

Coal Mines

Coal Mining Laws of the State of Wyoming, Revised 1969-1973, Wyoming Statutes, 1957 Title 30, Mines and Minerals Sections 30-97 to sections 30-201, and Sections 30-239 to Sections 30-250.

Chapter 4

Article 1: General

Sec. 30-144: Use of Internal Combustion Engines Prohibited

The use of mining locomotives, pumping engines, hoists, trucks, or any other form of machinery driven or propelled by internal combustion engines, in which power is generated by burning within the cylinder or cylinders, a mixture of air and gas, or air and alcohol, gasoline, fuel oil, oil distillate, or other liquid fuel, within any coal mine or mines, except diesel-powered equipment, which is operated in compliance with federal regulations and regulations established by the state mine inspector, is hereby declared to be unlawful, and any person, or persons, body corporate, agent, manager or employer, who violated any of the provisions of this section is guilty of a misdemeanor, and upon conviction thereof, shall for each offense, be fined not more than \$200, or imprisoned in the county jail for a period of not more than four months, or both.

Sec. 30-167: Machinery giving off noxious fumes prohibited underground.

Nonpermissible internal combustion engines or other machinery which gives off noxious fumes shall not be permitted underground in any coal mine.

Metal and Nonmetal Mines

Wyoming Noncoal Mining Laws, 1971.

Chapter 3 Mining Operations Generally

Sec. 30-93 Requirements as to Underground Equipment

The use of equipment underground which is powered by internal combustion engines shall be limited to the type constructed so as to conform to the standards approved by the U.S. Bureau of Mines for underground internal combustion engines. Such equipment shall only be used and operated under conditions approved by the Inspector of Mines.

CONCLUDING STATEMENT

A considerable variety of regulatory responsibility exists amongst the States, which seems to depend on the extent and type of mining activities within these States. In some States where there is little or no mining, the Federal inspection and enforcement regulations of the Mine Safety and Health Administration, the Occupational Safety and Health Administration, and the Environmental Protection Agency are used. States that have specific regulations pertaining to mining differ considerably in their administration. Some allocate these responsibilities to agencies concerned with labor, workmen's compensation, industrial safety, or related matters. Other States that have a long history of mining activity place responsibilities in agencies specifically concerned with mines and mining. Still others incorporate mining responsibility functions in departments or bureaus concerned with agriculture, conservation, reclamation, environment, or natural resources.

Since 1976, the number of active underground metal and nonmetal mines has remained at about 600. The number of active underground coal mines, however, has increased 56 percent to approximately 3,600. The Code of Federal Regulations written exclusively for diesel equipment in coal mines has not yet been established. It is generally agreed to apply Title 30, Part 36 (the old Schedule 31) with some modifications to underground coal mines; Part 36 currently applies to gassy noncoal mines. In metal and nonmetal mines, no regulations are known to prohibit the use of diesel engines, but several States have minimum ventilation requirements or require add-on devices such as scrubbers, catalytic converters, or exhaust dilution devices. Gasoline or other nondiesel engines are virtually eliminated, but their use is still legal in some States if certain conditions are met. In some cases, both State and Federal enforcement agencies require that diesel equipment comply with their own regulations, all of which contain variations in requirements.

Regulations also affect diesel equipment design. A substantial proportion of mine production is attributable to the use of mobile diesel-powered equipment in the form of load-haul-dump vehicles, haulage trucks, personnel carriers, supply vehicles, and roof bolting equipment. The direction of future design and development of diesel equipment will depend to a great extent on future legislation and subsequent regulations. Safety legislation is continually being updated to suit experience, leading to an ever-increasing number of regulations and added cost of manufacture. Localized and specialized regulations result in manufacturers building custom equipment to fill regional needs rather than employing less expensive mass production.

This publication is intended to delineate State regulation of underground diesel equipment to reduce confusion on the part of manufacturers, mining companies, labor, inspection agencies, and the certification and approval authority. Additionally, it is hoped that it will be a positive step toward the establishment of pertinent regulations designed to preclude hazardous operating conditions, and of regulations that are uniform to the extent possible to reduce the burden on industry.





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